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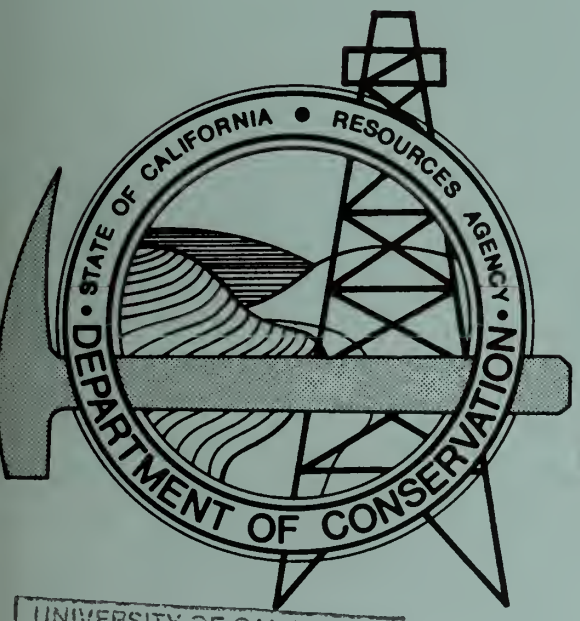

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JAMES F. DAVIS
STATE GEOLOGIST

SEVENTY-FOURTH REPORT OF THE STATE GEOLOGIST

ACTIVITIES OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY JULY 1,1980 THROUGH JUNE 30, 1982

James F. Davis, State Geologist
California Department of Conservation
Division of Mines and Geology
1416 9th Street, Room 1341
Sacramento, CA 95814

FOREWORD

Those who make land-use decisions in both the public and private sectors in California must accommodate the urban expansion and sound economic growth necessary to an expanding population and still enable the maintenance of an acceptable environment. Mineral resources and geologic hazard appraisals are extremely important. The levels of understanding behind such decisions range from broad general knowledge of California's complex geology and mineral resources to detailed knowledge of the geology and resources of a specific site.

To facilitate these broad and specific processes, the California Division of Mines and Geology (CDMG) is engaged in three information-related activities. These are: (1) information collection, which includes geologic research and applied geologic investigations; (2) advisory review services to the local, state, and federal agencies on such matters as environmental impact, outer continental shelf development, critical facilities design, mined land reclamation, and mineral resources potential; and (3) information distribution, which includes information services, both oral and written, from the three CDMG district offices, publication of CALIFORNIA GEOLOGY, a monthly magazine, and publication of reports on geologic research and applied geologic investigations. Many Division programs generate information that is reported through all of these information activities.

For example, the Division conducts statewide and local programs for identification, reduction, and mitigation of seismic and other geologic hazards, to minimize loss of life and damage to property. These include the fault evaluation and zoning (Alquist-Priolo) program, the earthquake hazard reduction program, the earthquake strong-motions monitoring program, and the site evaluation and review program. The Division also conducts a vital program, mandated by the Surface Mining and Reclamation Act of 1976 (SMARA), that involves the identification of mineral resources before urban development has precluded the possibility of mining them. In addition, the Division develops basic geologic data with its regional mapping program.

All Division activities are based on the principle that knowledge of the fundamental geology of the state is important for the safety and economic well-being of the citizens of California.

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DIVISION PROGRAMS

The Division of Mines and Geology is the state geological survey for California. As such, its primary function is to provide technical data to assist public agencies and the private sector in the wise and safe use of the earth's crust, its terrain, and its mineral resources. The main objectives of the Division are: (1) to identify and provide timely delineation of geologic hazards; (2) to identify, delineate and assist in the ultimate utilization of deposits of minerals, both onshore and offshore, consistent with wise conservation practices; and (3) to compile and, where needed, develop basic data on the geology of the state, including regional and statewide mapping as well as geophysical and geochemical data, as either direct or indirect support for geologic hazard and mineral resource investigations.

Potentially hazardous geologic conditions must be identified prior to land development in order to protect the public from possible economic loss and injury. These hazards include landsliding, ground rupturing caused by fault movements, ground shaking caused by earthquakes, tsunamis (seismic sea waves), volcanic eruptions, land subsidence, expansive soils, and erosion. Deposits of mineral raw materials must be identified and delineated so that land-use planning can be conducted in the light of this information.

The following programs deal with environmental concerns and economic mineral resources.

Figure 1. Principal faults in California zoned for special studies under the Alquist-Priolo Special Studies Zones Act of 1972. Dashed lines and dates identify work-plan and priorities for studying areas under the Fault Evaluation Program, 1976 to 1987.

I. Geologic Hazards Program

Division activities directly concerned with geologic hazards are: (1) active fault evaluation and delineation as required by the Alquist-Priolo Special Studies Zones Act; (2) cooperative agreements with local government to identify geologic hazards; (3) installation, maintenance, and operation of strong motion instruments to provide data for earthquake resistant building design; (4) review of geologic/seismic reports on hospital, power plant, and dam sites, and of environmental impact reports; (5) geology as it relates to forest management; (6) investigation to understand and mitigate seismically related geologic hazards in the California-Mexico borderland area; and (7) mapping and interpretation of the geology in key forested watersheds of the northern Coast Ranges for the purpose of determining local potentials for landsliding and erosion. The Division also conducts, under legislative mandate, special hazards studies such as (8) the slope stability study of the Baldwin Hills.

1. Fault evaluation and zoning program

The Division's fault evaluation and zoning program was established by the Alquist-Priolo Special Studies Zones Act of 1972 (Public Resources Code, Division 2, Chapter 7.5). The objective of the law is to provide for the public safety from surface rupture in hazardous fault zones by restricting construction astride active fault breaks. Under the Act, the State Geologist delineates special studies zones about one-quarter mile wide along potentially hazardous faults, including the San Andreas, Calaveras, Hayward, and San Jacinto faults. Under guidelines adopted by the State Mining and Geology Board, local governments permit certain development projects in the special studies zones only after geologic studies show building sites to be free of hazardous faults.

During 1973, the first year of the program, special studies zones for the four major faults (named above) were delineated on 175 7.5-minute quadrangle maps (scale one inch equals 2,000 feet). After public review, Official Maps were issued on 1 July 1974. Subsequently, 126 new zone maps and 51 revised zone maps were issued, and 2 maps were withdrawn (see Table 1). Figure 1 shows the faults zoned to date.

Table 1. Official Maps of Special Studies Zones issued as of 30 June 1982.

DATE OF ISSUE	NEW MAPS	REVISED MAPS	WITHDRAWN MAPS
1 Jul 1974	175	-	-
1 Jan 1976	81	5	-
1 Jan 1977	4	3	-
1 Jan 1978	1	-	-
26 Jul 1978	2	-	-
1 Jan 1979	4	7	-
1 Jan 1980	21	9	-
1 Jan 1982	13	27	2
TOTALS	301	51	2

Although the initial zoning was based on available data for the four major faults, the 1974-75 zoning efforts demonstrated that reliance could not be based solely on the work of others. The Division clearly needed to rely more heavily on observations by Division staff, both in the field and by use of aerial photographs. Thus, a fault mapping and evaluation program was initiated in 1976 to consider the many other potentially active faults for possible new zoning. Previously zoned faults also are being evaluated for zone revisions when warranted by new information. The terms "sufficiently active and well-defined" (PRC, Sec. 2622) were defined to serve as specific criteria by which zoning decisions were made. The Division's fault evaluation and zoning program is described in more detail in the recently revised Special Publication 42, "Fault-Rupture Hazard Zones in California." A summary article also was prepared for the Division's monthly magazine CALIFORNIA GEOLOGY (July 1980 issue).

During fiscal years 1980-81 and 1981-82, fault evaluation work was completed in the southern San Francisco Bay region (1979-1980 area of Figure 1). This work, the fourth region studied under the fault evaluation program, commenced in May 1979 and was planned for completion by April 1980. However, the completion date was delayed one year as a result of several earthquakes -- August 1979, October 1979, January 1980, and May 1980 -- which caused a diversion of program staff in order to map the fault rupture features associated with the earthquakes. Completion of the 1979-1980 studies resulted in 38 in-house, fault evaluation reports (FERs) on the Hayward, Calaveras, San Andreas, Sargent, Greenville, Las Positas, and other faults. In addition, FERs were prepared on the Maacama (portions), Imperial, Brawley, and Hilton Creek-Long Valley faults, which are outside the study area. The FERs provide data on fault recency, sense and magnitude of displacement, and other information needed to make zoning decisions.

As a result of the 1979-1980 studies, many new and revised Special Studies Zones were proposed with the issue of Preliminary Review Maps on July 1, 1981. In addition, established zones delineated on two Official Maps were proposed for withdrawal. Following public review and minor revisions, 13 new and 27 revised Official Maps were issued January 1, 1982. In May 1981, fault evaluations commenced in the northern Coast Ranges (Figure 1). These evaluations were scheduled for completion in April 1982, but the work was delayed six months due to the diversion of staff to map and evaluate the landslide and debris flow damage caused by the intense rains of January 4, 1982. By the end of June 1982, nine FERs had been completed for all parts of the Maacama, Green Valley, West Napa, and other faults of the northern Coast Ranges, and work on 11 other FERs was underway.

Fiscal 1980-81 and 1981-82 work was carried out by a Program Supervisor, two Project Geologists, and a Geologic Aid. The work was summarized on Open-File Report OFR 81-3SF. Reports were completed on ground rupture associated with the Mammoth Lakes earthquakes of May 1980 (in Special Report 150 and OFR 80-12SAC). Detailed maps also were prepared for open-file release on the Greenville, Imperial, and Brawley faults and segments of the Sargent, San Andreas, and Calaveras faults (OFRs 81-5, 81-6, 81-7, 81-8, and 81-9SF).

In addition to evaluating and zoning faults, other functions of the Division under the Alquist-Priolo Special Studies Zones Act include (1) the filing of geologic reports for development sites within the special studies zones and (2) review of waiver requests in lieu of a geologic report (PRC,

Sec. 2623). By the end of the 1981-82 fiscal year, a total of 1,461 geologic reports were on file and available for reference at the San Francisco District Office. An index map, Open-file Report OFR 76-6SF (last revised 1979), identifies the sites investigated for faults under the Act. Four waiver requests were submitted during the two fiscal years (63 requests were processed previously).

Finally, an important activity of the program staff is to provide information on the Alquist-Priolo Act, CDMG's fault zoning and evaluation program, and on fault-rupture hazards to both the public and private sectors. It is estimated that program staff spent 15 to 20 percent of their time responding to hundreds of inquiries by geologists, planners, building officials, realtors, developers, financial institutions, and others.

2. Cooperative studies with county and local governments

The Division conducts a number of geological studies in cooperation with local government and other state agencies to provide needed technical information about actual or potential areas of geologic hazard and mineral resources. Cooperative activities are funded jointly by the Division and the cooperating agency under various arrangements, the nature of which depends upon the availability of funds and personnel, the relative urgency of the project to the State and to the cooperating agencies, and other factors. Cooperative activities with counties were either suspended or reduced owing to changed budgetary conditions of both counties and the state after July 1, 1978.

a. Los Angeles County

The Los Angeles County Flood Control District reinstated funding ($15,500) in the 1980-81 fiscal year for continued work to accelerate the Division's geologic studies, initiated under previous funding arrangements, in Los Angeles County. The County of Los Angeles, Department of County Engineer, was unable to participate in this program as they had under the previous arrangement.

The County of Los Angeles, Department of County Engineer, also was unable to provide funds to accelerate the Division's cooperative fault hazards study with the U.S. Geological Survey (Earthquake Hazard Reduction Program) along the San Andreas fault zone in the northern portion of the County. Work continued, however, on a reduced basis. The final phase of the investigation, preparation of a summary report, was initiated.

b. Orange County

No funds were provided by the Orange County Environmental Management Agency (Department of Building and Safety, Road Department, and Orange County Flood Control District) for continued work to accelerate the Division's geologic studies in the county. Work continued, on a reduced basis, on projects initiated and well-advanced under previous funding arrangements. The Division and the U.S. Geological Survey continued to cooperate in an investigation of the ground response from seismically induced shaking in a portion of Orange County.

c. Sonoma County

In early fiscal year 1981-82 the report and maps for a study of the environmental geology of the Occidental-Sebastopol area were completed by the Division and the final documents were delivered to the county.

3. Strong Motion Instrumentation Program

One of the primary problems confronting structural engineers in their efforts to design earthquake-resistant structures is the lack of knowledge regarding the force of ground motion and the deformation induced in structures and facilities by earthquake-generated ground motion. In late 1971, Chapter 8 of Division 2 of the Public Resources Code (SB 1374) was signed into law to establish a Strong Motion Instrumentation Program (SMIP). The California Division of Mines and Geology was designated as the responsible managing agency.

The Division is installing, maintaining, and monitoring a network of strong-motion instruments to study the nature of strong earthquake motion and to collect, process, and disseminate data for application to the design of earthquake-resistant structures. This activity is supported by a special fund derived from a fee applied to construction permits issued by cities and counties.

The SMIP objective is to obtain statewide detailed records of the response of rock and soil units and of engineered structures to ground motions generated by earthquakes. The accelerograph, an instrument that measures the forces generated by seismic waves, is used to record these data.

During the fiscal years 1980-81 and 1981-82, the Strong Motion Instrumentation activity, operated by the Office of Strong Motion Studies from Sacramento and San Bernardino, completed ten years of operation.

In cooperation with the U.S. Geological Survey and the U.S. Department of Transportation, a project to instrument the Vincent Thomas Bridge in Los Angeles was initiated in September 1980. This project is the installation and monitoring of a 26 channel, analog recording system on the bridge with another three channels located on the ground in close proximity. The project was completed in October 1981 with the instrument system provided by the Department of Transportation, installation and operation by the Division, and project management by the U.S. Geological Survey.

The buildings, transportation facilities, lifeline facilities, and ground response sites to be used as data collection stations in the program were selected with the advice and assistance of the Strong Motion Instrumentation Committee of the Seismic Safety Commission. The Committee encourages a variety of individuals, organizations, and agencies to nominate sites and structures for instrumentation. In this way, the Committee has prepared a list of nominations for instrumentation that included 70 buldings, 49 transportation structures, 30 dams and 17 lifeline facilities such as power plants and water transmission, treatment and storage structures. In addition, the Committee has assisted in the selection of approximately 280 ground response sites, and is presently preparing an additional list of 50 buildings. Ultimately, the program network is to include a total of about 400

buildings, 30 dams, 50 transportation structures, 50 lifeline facilities, and 500 ground response sites.

Instrumentation activity during these two years included the installation of 41 ground response stations with a total of 123 seismic data traces, and the instrumentation of 8 buildings with a total of 112 seismic data traces, the Vincent Thomas bridge with 26 seismic data traces, and 1 dam with 3 data traces. A great deal of effort was expended in a project of construction of 43 ground response stations in a carefully designed dense array in the vicinity of Parkfield. Fifteen stations were installed, and completion of this array is expected during fiscal year 1982-83. At the end of the 1981-82 fiscal year, a total of 285 permanent and 4 temporary ground response stations representing 867 seismic data channels, 54 buildings representing 653 data channels, 19 dams representing 211 data channels, and 5 transportation structures representing 103 data channels were installed and operating. Figure 2 shows the status of the Program as of June 30, 1982.

A Data Management function was an important addition to the SMIP activity, raising its status to a complete and comprehensive program with the capability for processing and dissemination of data to the user community. Initial steps to develop this data processing capability were taken immediately after the authority and mandate to do so were provided by the adoption of Chapter 1243, Statutes of 1976, on January 1, 1977. A departmental Feasibility Study Report (FSR) was prepared for and approved by the State Department of Finance, and initial funding for the project initiation was approved in fiscal year 1979-80. During fiscal years 1980-81 and 1981-82, the equipment for a data digitizing and computing system, adapted from an existing system operating at the University of Southern California, was delivered, installed, and made operational. Routine record processing is scheduled to begin in early fiscal year 1982-83.

During the reporting period, the Program operated in accordance with the functional organizational chart shown in Figure 3. Expenditures by the Program were $2,667,000, resulting in a net reduction of the Strong Motion Instrumentation fund of $539,000.

4. Advisory Services - geologic/seismic review

Advisory Services provides reviews of geological, seismological, and mineral resource aspects of technical reports produced by other State, federal, and local government agencies. The purpose of the CDMG reviews is to provide assurance to those agencies that the treatment of the geologic, seismological, and mineral resources aspects of those reports has been thorough and accurate, and has applied state-of-the art technical methodology with respect to any geological hazard or mineral resource issues that may be present. This program delivers technical information and interpretive judgements that have been developed in CDMG information-gathering programs.

Activities under Advisory Services involved the Coastal Commission, Auburn dam, Warm Springs dam, the Nuclear Regulatory Commission, the Point Conception LNG site, hospital sites, Environmental Impact Reports (EIR), Alquist-Priolo waivers, reclamation plans, and timber harvest plans. Reimbursements for work done by the Advisory Services Group were provided by the Public Utilities Commission, the Office of the State Architect, and the Coastal Commission.

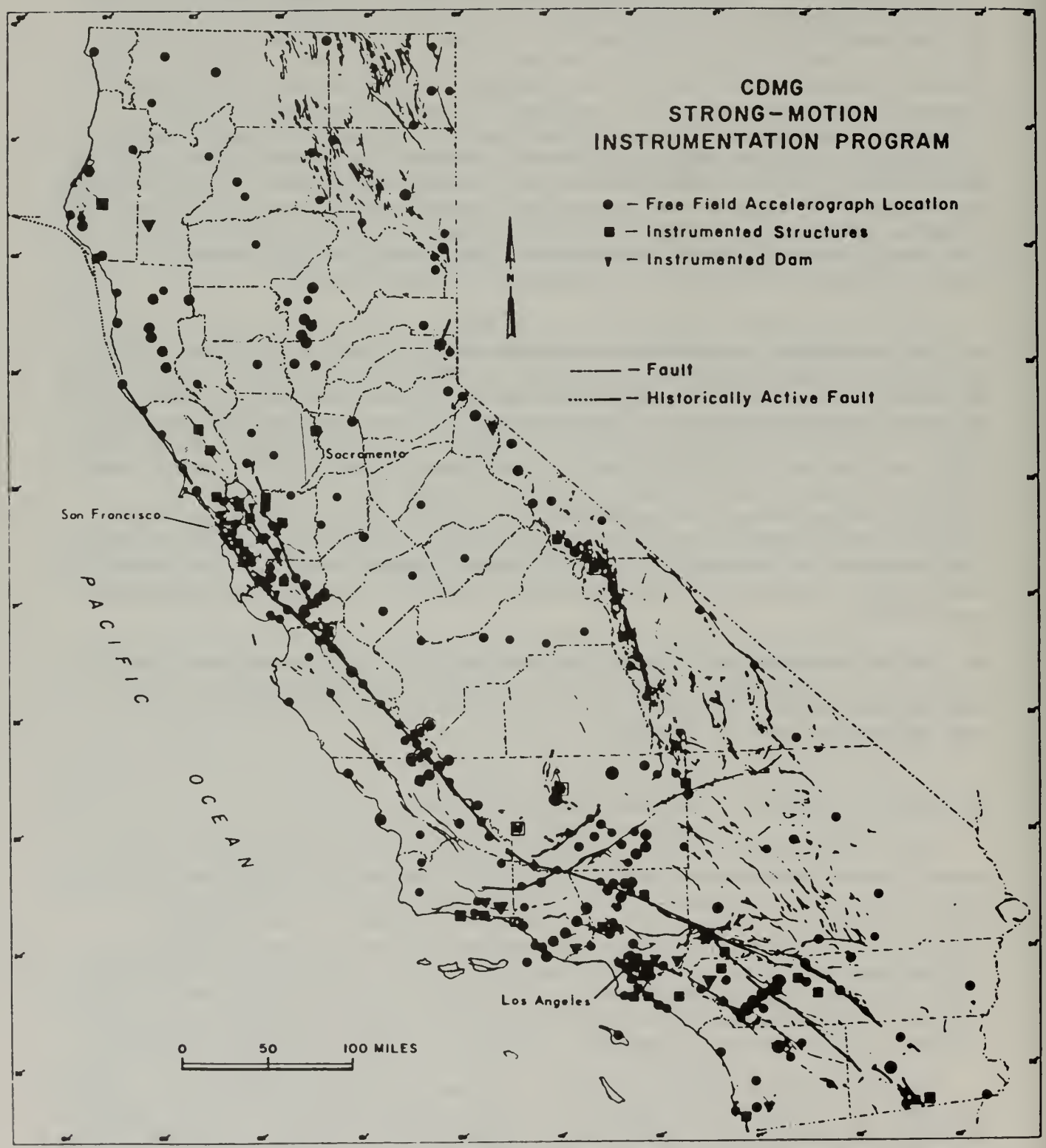

Figure 2. Status of the Strong Motion Instrumentation Program, June 30, 1982.

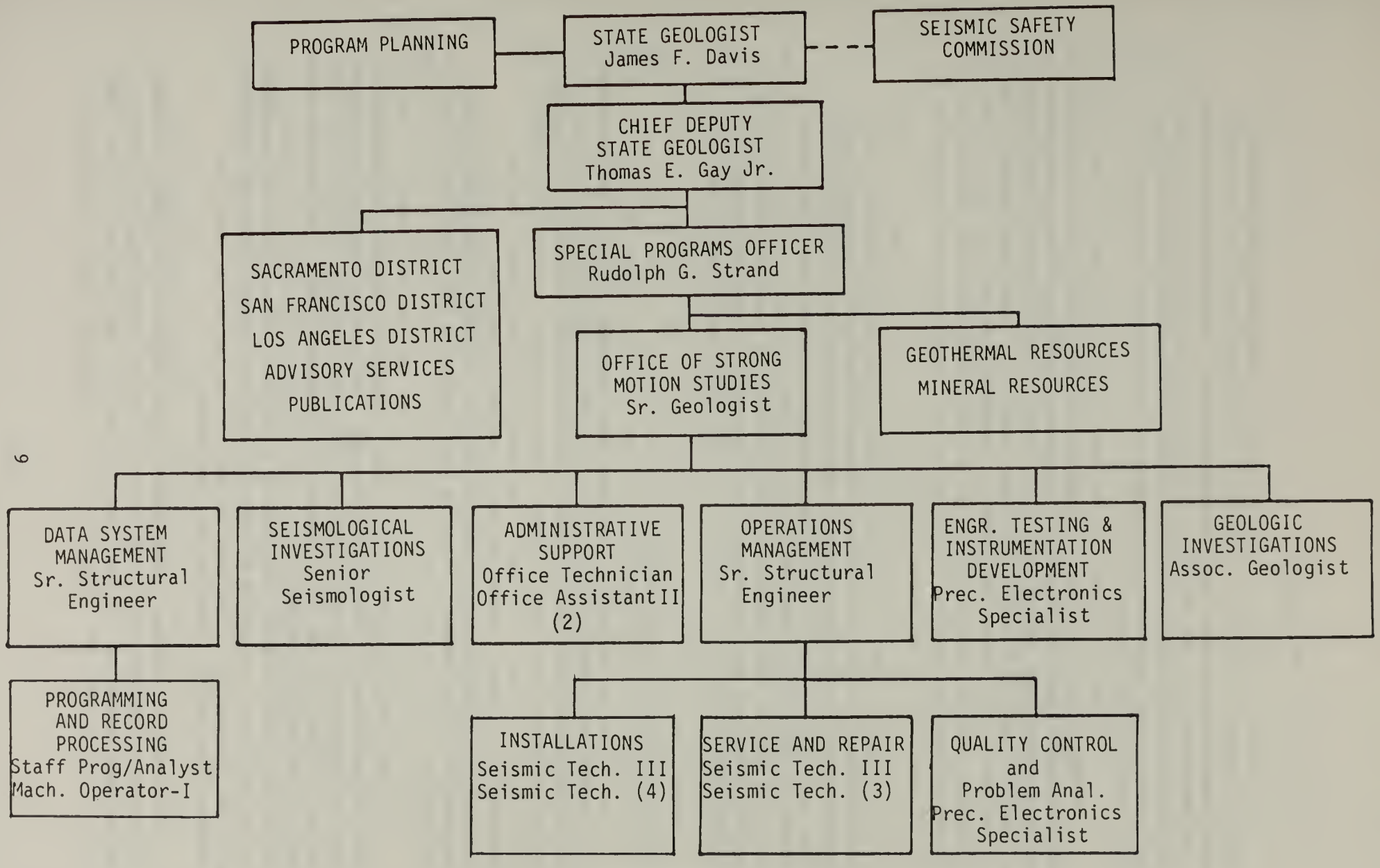

Figure 3. Organization chart for the Strong Motion Instrumentation Program, June 30, 1982.

a. Coastal zone developments

A contract with the California Coastal Commission provides for Division staff to review the geologic and seismic safety of proposed developments when requested by the Commission. Reimbursement is on a case-by-case basis, and Division review requires a site visit as part of the engineering geologic appraisal. Most of the work is in southern California where intensive development is occurring in areas of potentially unstable sea cliffs.

A fifteen-month contract (beginning October 1979) with the California Coastal Commission (CCC) provided 80 percent funding for Division staff to review a California Energy Commission (CEC) report on Coastal Power Plant expansion feasibility and to provide a series of reports of geologic and seismic data significant for planning, site selection, and review of potential critical energy facilities sites in specified portions of the California coastal region. Six reports were completed and transmitted to the CCC and CEC during fiscal 1980-81.

In November 1980, the Division began work compiling maps of the marine geology of the California continental margin. The activity is funded by the California Coastal Commission (CCC) with a combination of State and federal moneys. An understanding of the offshore geology is crucial in making land-use decisions regarding coastal areas. As of June 30, 1982, maps of the offshore geology along the coast from the Mexican border to Ventura had been completed for review, and compilation of maps for the remainder of the California continental margin was underway.

b. Environmental impact reports

The Division continued to review Environmental Impact Reports (EIRs) which covered a variety of projects, including sites for power plant facilities, outer continental shelf projects, subdivisions, school sites, mining activity, dam sites, nuclear waste programs, and hazardous waste disposal sites. The problems of earthquake shaking, fault rupture, landsliding, erosion, expansive soil, tsunami, subsidence, volcanic eruption, mineral resource conservation, and mined-land reclamation are considered in the review, following the Division's EIR guidelines (CDMG Note 46).

The Division's staff has continued to spend a significant amount of time in the review of federal regulations and reports relative to nuclear waste storage and disposal. Federal agencies providing documents for review included the Nuclear Regulatory Commission (NRC), the Department of Energy, and the Environmental Protection Agency. During fiscal year 1980-81 and early fiscal year 1981-82, the Division was actively involved in the NRC Waste Confidence Rulemaking, which required close coordination with the Governor's Office and the Energy Commission in preparing responses to the NRC regarding nuclear waste.

In addition, during fiscal years 1980-81 and 1981-82, CDMG provided assistance to the Office of the Attorney General regarding the geologic and seismic issues on the California School for the Deaf and Blind. CDMG also testified on these issues at the U.S. Federal Court in Sacramento.

c. Hospital site reports

The Division continued to review reports under the provisions of the Hospital Safety Act (Health and Safety Code), which became effective March 7, 1973. This Act requires that new hospitals, including additions, reconstructions, and out-patient facilities, be functional during and after an earthquake or other natural disaster. The Division reviewed new and supplemental geologic/seismic hospital-site reports that were submitted by consulting engineering geology firms to the Office of the State Architect. Along with the review activity, Division staff continued to attend regular meetings of the State Building Safety Board and the geotechnical subcommittees to develop new administrative regulations and provide input in the Board's studies on the evaluation of the safety of hospitals in the southern California area.

d. Other critical facility developments

Auburn dam site. The Division continued its review of the proposed U.S. Bureau of Reclamation (USBR) Auburn dam, the site of which is located in the same Foothill shear zone that generated the 1975 Oroville earthquake. During the latter part of fiscal 1979-80, CDMG staff reviewed the Draft Supplement No. 2 to the Final EIS on Auburn Dam. Because the fault-slip design parameter was not clearly stated in the document, the State Geologist asked for clarification of whether the USBR is using the 5-inch or the 9-inch fault-slip parameter in its current studies of the two alternative designs for the dam still being considered. On October 29, 1980, the State Resources Agency integrated the Division's comments along with those of the Departments of Boating and Waterways, Conservation, Fish and Game, Parks and Recreation, Water Resources, Health, and Transportation, and the Air Resources and State Water Resources Control Boards, and transmitted the State's review of the EIS draft supplement to the USBR.

Point Conception LNG site. The Division has continued to address CPUC on the geologic and seismic issues of Point Conception LNG site. A major result of the Division's field visits and review of the numerous studies by consultants was the preparation of the CDMG report, "Geologic and Seismic Hazards Evaluation of the Proposed Little Cojo Bay LNG Terminal Site, Point Conception, California," January 1981. Ten staff members of CDMG coordinated their efforts to prepare this report which was submitted to CPUC relative to their public hearings on the geologic and seismic issues. CDMG continued its review activity for CPUC with testimony at public hearings. During early fiscal year 1981-82, CDMG completed this involvement with CPUC on the LNG site.

Vallecitos nuclear facility. The Division continued its involvement with the NRC as part of the geologic and seismic review

of the General Electric Test Reactor (GETR) facility at Vallecitos. Although most issues were resolved in the Division's Special Publication 56, "Geologic Evaluation of the General Electric Test Reactor Site, Vallecitos, Alameda County, California, August 1979," certain geologic and seismic issues relating to engineering design remain, and the Division is continuing its review of reports on the project submitted to the NRC by the U.S. Geological Survey and consultants for GETR. CDMG attended several public hearings sponsored by NRC on the project. The operations of the facility continues to be suspended.

Warm Springs dam site. The Division staff continued to review and examine the geology at Warm Springs dam site as part of the joint Federal/State site-review process. All the major concerns regarding the site, including the stability of the spillway area, were resolved during fiscals 1980-81 and 1981-82.

Diablo Canyon nuclear facility. The Division staff continued its efforts to obtain all recent scientific information and NRC material relative to this project as part of an ongoing review. During fiscal year 1981-82, CDMG completed the review of the evacuation plan for the Diablo Canyon project, for the State Office of Emergency Services.

San Onofre nuclear facility. During fiscal years 1980-81 and 1981-82, Division staff continued to review geologic and seismic reports on San Onofre Nuclear facility submitted to the Nuclear Regulatory Commission by the Southern California Edison Company. The Division staff attended several meetings involving technical discussions which were presented by consultants for the utility. The significant geologic and seismic issues relating to the design earthquake based upon the activity of the offshore faults were adequately resolved during fiscal 1980-81. However, because of public concern on the safety issues of San Onofre nuclear project, the Division continued to participate actively with the NRC and public interest groups to resolve these issues. During early fiscal year 1981-82, CDMG completed its participation with other agencies on geologic issues regarding the San Onofre nuclear project.

5. Advisory Services - geology and forest management

During fiscal year 1980-81 Advisory Services staff advised the Department of Forestry on the adequacy of timber harvest plans. One geologist, assigned to a Department of Forestry long-term soil erosion study, completed this study and was reassigned to a headquarters position. On a statewide basis, most geologic problems in timber harvesting occur in the Coast Ranges; consequently, the geologists were assigned to Eureka and Santa Rosa, respectively. Beginning in fiscal year 1981-82, this activity was assigned to the Forest Watersheds Mapping Program (see page 13).

6. Cal-Mexico Geologic Hazards Program

The Cal-Mexico Geologic Hazards Program was established to identify and integrate understanding of seismic hazards on the California side of the California-Mexico border. Through this Program CDMG is playing a lead role in

a collaborative effort involving the U.S. Government, the Federal Mexican Government, the State of Baja California, and the State of California. The purpose of this collaboration is the collection of geological, geophysical, and seismological data for the purpose of delineating, describing, predicting, and mitigating seismically related geologic hazards in the borderland area.

The Program was designed during fiscal year 1981-82, and plans were adopted for preparing the following products during fiscal year 1982-83: (1) a preliminary geologic map of the borderland; (2) a lineament map based on air and space imagery for interpretation of faults and joints; (3) a bibliography of pertinent data; and (4) a long-range research plan identifying specific seismic safety studies needed.

7. Forest Watersheds Mapping Program

The purpose of the Forest Watersheds Mapping Program is to gather and interpret data on the nature and extent of geological and soil units present in key forested watersheds of the northern Coast Ranges for the purpose of determining local potentials for landslides, hillside erosion, and streambank erosion. Products of the program are 7 1/2 minute quadrangle maps of selected areas. These maps emphasize surficial units present and the relative landslides and erosion hazards posed by each geological and soil unit. The California Department of Forestry will use the maps in its Timber Harvest Planning procedures, and the Board of Forestry will use them in the THP regulatory process. The work is funded by the Department of Forestry.

During fiscal year 1981-82 the Program's first year of operation, staff proceeded with field work, aereal photo interpretation, compilation of basic geology, and delineation of slopes greater than 70% for 16 of the 7 1/2 minute quadrangle maps. Also prepared were an interpretive legend of the landslide-related features shown on these maps and a checklist of factors that effect the landslide potential in each map category as well as land-management guidelines.

8. Special Baldwin Hills slope-stability study

This legislatively mandated study (AB 1571, Moore) of storm-related slope stability problems in the Baldwin Hills, begun in March 1980, was completed within the six-month deadline and submitted to Assemblywoman Gwen Moore (49th District). The findings were publicly released on November 4, 1980 as Open-File Report 80-14LA, "Slope Stability Study of the Baldwin Hills, Los Angeles County, California." The report describes the slope problems, assesses the causes and discusses possible reconstructive and preventative measures. Included with the text are numerous photographs and maps depicting slope failures, aerial geology, and individual properties damaged. Due to the value of this report as both a case study and a general evaluation of storm-related damage, it was revised and rewritten for general release as a Special Report, and is now being printed.

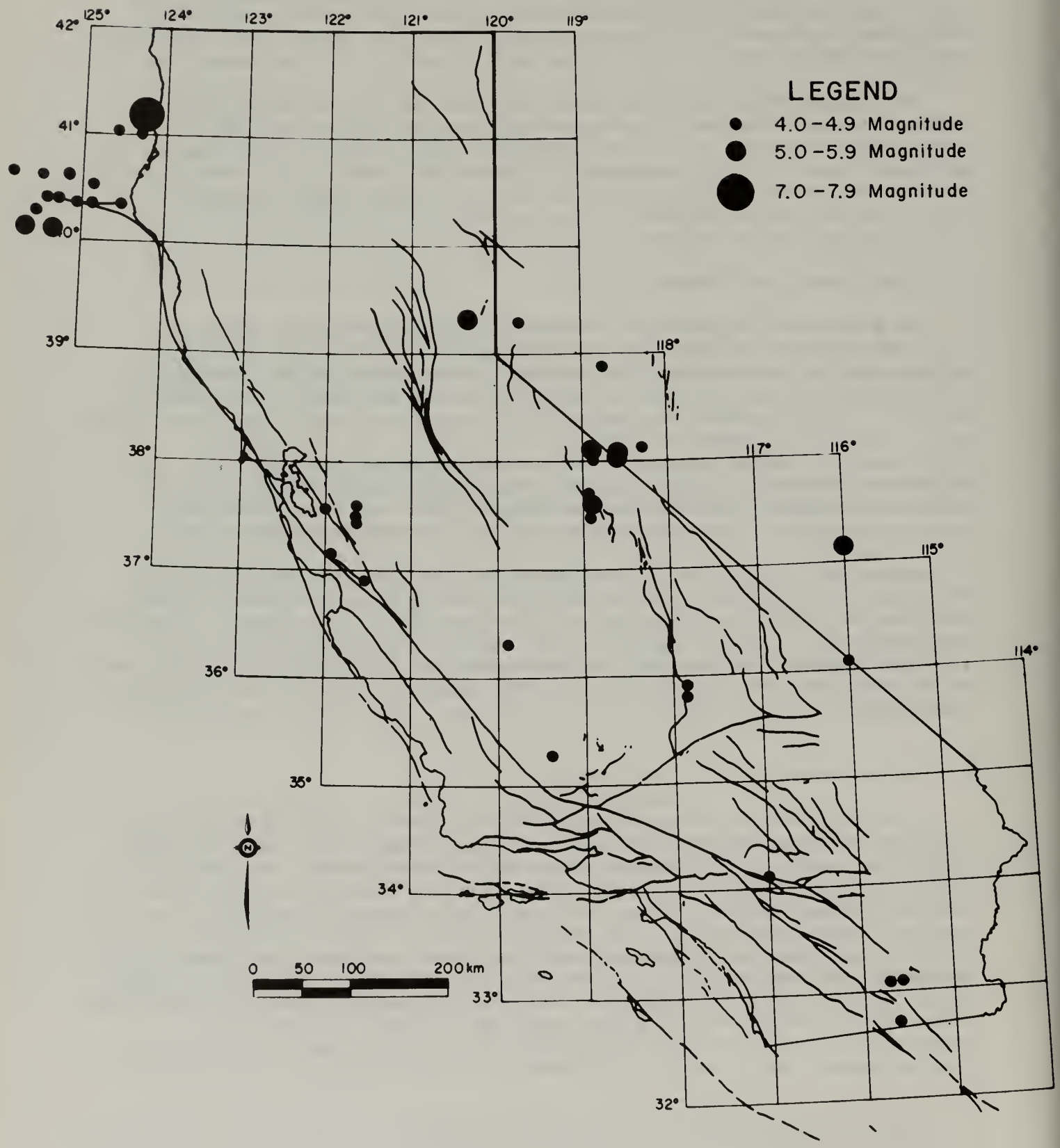

Figure 4. California seismicity, June 1980 to June 1981.

II. Seismological/Geophysical Program

Under the Seismological/Geophysical Program, the Division (1) conducts microearthquake studies and monitored earthquakes to assist in the identification of active faults and to study possible reservoir-induced seismicity; (2) develops and maintains a comprehensive, historic earthquake catalog; (3) conducts crustal movement investigations; (4) develops gravity and aeromagnetic maps and provided geophysical support for other Division projects; and (5) maintains a modest program for the development of earthquake-prediction techniques.

1. Monitoring seismic activity

Microearthquake studies. Continued seismic activity, both in the Mammoth Lakes-Long Valley area (following a series of M6 earthquakes during May 25-27, 1980) and east of Mono Lake in California (following an M5 earthquake in Huntoon Valley, Nevada, on June 29, 1980), has been monitored with up to six CDMG seismograph stations to augment existing regional seismograph coverage. Three stations were maintained near Mammoth Lakes, California, one just south of Lee Vining (southwest of Mono Lake), one near Benton (southeast of Mono Lake, at the California/Nevada border), and one at Bridgeport (north of Mono Lake).

Mainshocks and aftershocks for the May 1980 Mammoth Lakes sequence have been analyzed by Division staff. The sequence initiated with movement on a previously unknown fault (tentatively named the Casa Diablo fault zone) in Long Valley Caldera, lying west of the Hilton Creek fault. The aftershock zone expanded beneath Laurel Canyon. Since the end of May 1980, no significant increase of activity has occurred in the Mammoth Lakes aftershock zone. Background information, a description of post-earthquake field programs, and tentative results developed from these earthquake studies were published as CDMG Special Report 150, "Mammoth Lakes, California Earthquakes of May 1980."

Earthquake monitoring. Three visible seismographic recorders displayed at the Sacramento District office receive telemetered signals from permanent located in northern, central, and southern California. These recorders help seismologists plan appropriate response to significant earthquakes within the state.

In addition to the above seismographs, two more are on display: one at the State Capitol, and the other in the lobby of the Resources Building. These recorders are to promote public awareness of the California earthquake activity. They have been popular exhibits since their installation.

The seismic activity for events of M4 or greater for this fiscal year is shown in Figure 4; a significant event of M7 occurred during November 1980 off the northern California coast. This was the largest earthquake to occur within California since the 1952 Kern County earthquake. No shocks of M6 were recorded during this reporting time period.

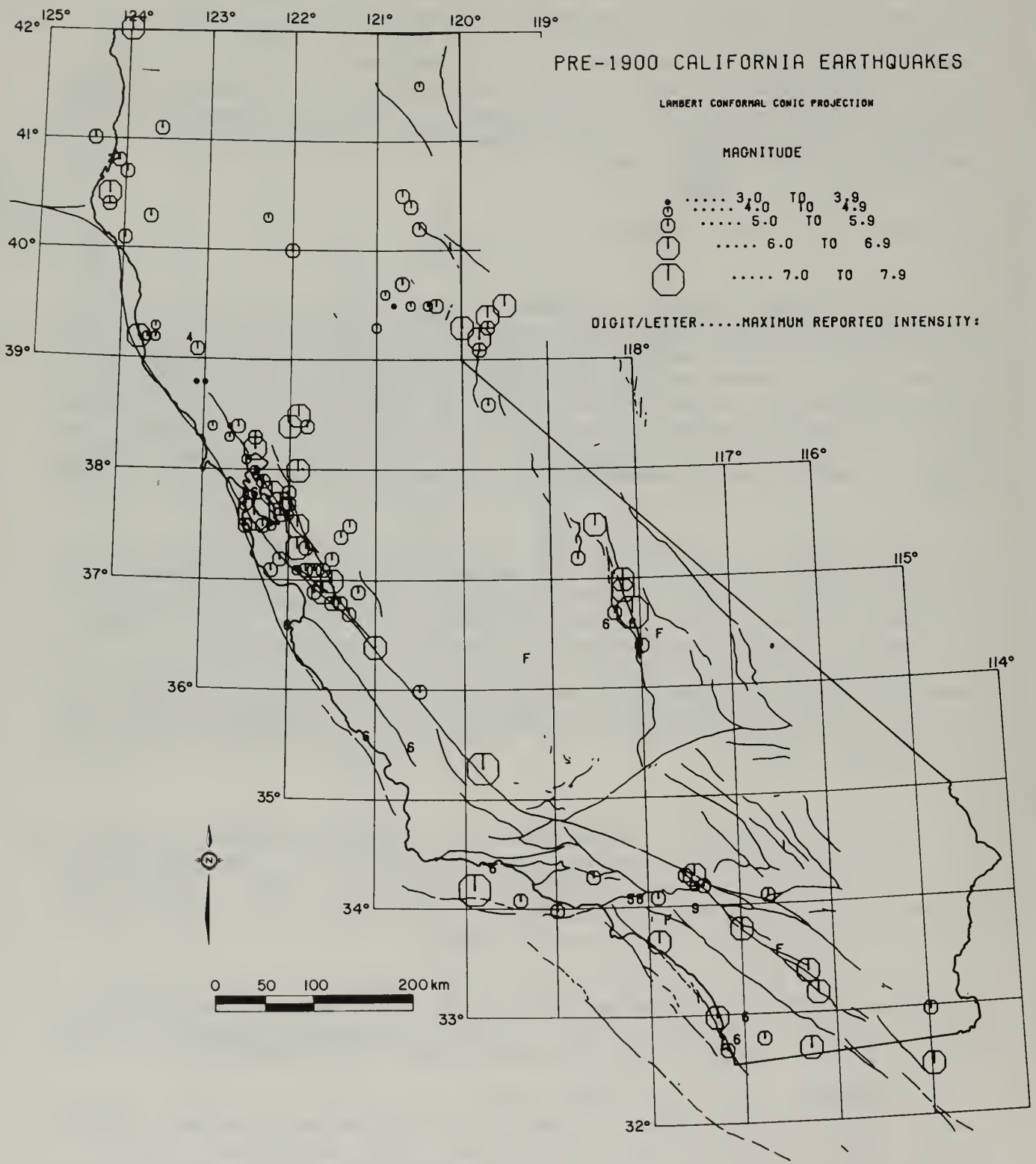

Figure 5. Epicenters of pre-1900 California earthquakes.

2. Pre-1900 California earthquake history

A three-year project, funded by a grant from the U.S. Geological Survey to clarify the earthquake history of California for the period before 1900, was concluded and a final report submitted to the USGS. One-hundred and thirty-seven earthquakes were researched and nearly twelve thousand newspaper issues were examined for earthquake reports; about one-quarter of the issues searched provided earthquake reports.

The earthquake reports were summarized with emphasis on the information used to assign Modified Mercalli intensities. The strength and spatial distribution of the reported earthquake effects were used to estimate the magnitude and epicenter location of the earthquakes. As a result of this study, a set of 100 isoseismal maps (CDMG Open-File Report 81-11 SAC) were prepared which show the distribution of the reported intensities. Figure 5 shows epicenters of pre-1900 California earthquakes studied in this project.

High points of this investigation were: (1) confirmation that the spatial distribution of pre-1900 earthquake epicenters is similar to the spatial distribution of twentieth century earthquake epicenters; (2) discovery of evidence suggestive of surface faulting, not previously identified, for nine earthquakes; (3) absence of evidence in support of reported surface rupturing of the Big Pine fault in southern California during the 1852 shock; (4) discovery of evidence suggesting that fault rupture reported with the 1869 Nevada earthquake may be 20 km south of Reno rather than along the Olinghouse fault 30 km northeast of Reno; (5) discovery of proof that a number of previously reported destructive earthquakes were small (less than M5); (6) identification for the first time of approximately a dozen large shocks (M5 or greater).

Completion of the pre-1900 California earthquakes study, extends the coverage of the CDMG Earthquake Catalog as far back in history as the records permit. The CDMG Earthquake Catalog is an important source of basic information for the seismic evaluation of sites within the state by private and public agencies. To further refine the post-1900 coverage of the Catalog, investigation of selected damaging post-1900 shocks has begun.

3. Crustal movement investigations

Detecting and measuring deformation of the Earth's crust are essential in the Division's efforts to identify and mitigate seismic hazards in California. The nature of the movement detected can reveal much about the hazard potential, and such information may prove to be of value in forecasting dangerous earthquakes.

The Division's short range (2 km), infra-red, electronic distance-measuring (EDM) system was used to continue several surveys to monitor fault creep. These included resurveys on the San Andreas fault near Cholame and in the Temblor Range in San Luis Obispo County, on the Pleasanton fault in Alameda County, and on the Healdsburg-Alexander Valley fault in Sonoma County.

Geodetic studies were conducted in conjunction with other Division projects--for example, studies of the Livermore earthquakes and Mammoth Lakes earthquakes, and investigations in the San Joaquin Valley. Assistance was also provided in support of Division geothermal projects for the California Energy Commission and the U.S. Department of Energy.

4. Geophysical surveys

The Division conducted a number of geophysical surveys during fiscal year 1980-81. Some of these were in support of geologic projects to help define subsurface structures, and others were primarily geophysical studies. The geophysical data resulting from these studies are used principally to define fault zones, locate mineral deposits, and define favorable areas for geothermal resources.

a. Gravity maps

Activity continued on the Gravity Maps of California project. The State Gravity Map (GDM No. 3), at a scale of 1:750,000, and a text to accompany this map (Bulletin 205) were printed and released in 1981.

The following 1:250,000 scale gravity maps (1^{o} by 2^{o} degree quadrangles) that had been submitted for publication have now all been drafted and are being reviewed and corrected: revised Santa Cruz, Susanville, Chico, Sacramento, Walker Lake, Mariposa, Fresno, Santa Maria, Long Beach, Salton Sea, and San Diego-El Centro. In addition, the Santa Ana and San Bernardino sheets are in preparation.

b. Aeromagnetic maps

Preparation of the 1:250,000 scale aeromagnetic map of the Alturas sheet is now nearly complete, and other sheets are in preparation. The completion of most of the remaining map sheets will depend on the progress of aeromagnetic surveys in the state. A revised aeromagnetic index map of the state is in preparation. A new aeromagnetic map of the Cascades region in California, made by Oregon State University, has been submitted for possible publication.

c. Geophysical instrumentation

New instrumentation acquired by the Geophysical Section this year includes a digital tape recorder for use with the 12 channel enhancement seismograph. This can be used to record the final data at any monitoring location for future playback and analysis. The output of the recorder can be entered directly into a computer. A Texas Instrument model 59 programable hand calculator was also obtained. Many geophysical calculations, including modeling of gravity, magnetic, and electrical resistivity anomalies, can be done more efficiently with this equipment.

d. Geophysical report on The Geysers

A report on interpretation of geophysical data in the vicinity of The Geysers was completed and submitted to the Division of Oil and Gas under an Interagency Agreement. This report was combined with reports on the geology and reservoir assessment at The Geysers by the Division of Oil and Gas and published in 1981 as Division of Oil and Gas Publication No. TR27.

e. Geophysical projects to support other investigations

Geophysical field and office support for several geothermal investigation and site reviews was provided in the form of magnetic, gravity, seismic refraction, and electrical resistivity surveys and data analyses. The geophysical surveys provided information pertinent to the identification of buried faults, as well as the determination of local bedrock and water depths, variations in the thickness of subsurface strata, and the magnetic properties, seismic velocity, electrical resistivity, and density of local rock units.

Geothermal studies supported include Department of Energy projects in Paso Robles, Calistoga, and San Bernardino and California Energy Commission projects in Santa Rosa, Rohnert Park, and Sonoma. Site reviews include those for the Point Conception LNG site and the Berkeley School for the Deaf and Blind.

5. Earthquake prediction studies

The Division is using, or has the capability of using, four techniques for studying earthquake precursory effects.

Gravity. The gravity technique consists of monitoring a series of gravity stations along the San Andreas or other active faults in the state. Stations are monitored every three to six months to detect elevation and/or mass changes that may precede an earthquake. The activity has been recessed because of budget restrictions. It could be resumed in the future, if circumstances indicate a renewed importance.

Telluric currents. The telluric current, self-potential method compares telluric current variations in order to indirectly measure rock resistivity changes that may precede earthquakes. The Division has operated three telluric current arrays along the San Andreas fault from the Parkfield vicinity to California Valley. Apparent precursory effects prior to a moderate earthquake in January 1975, a small swarm of earthquakes that occurred in April-May 1976, two separate small events that occurred in July and November 1977 were detected, but these effects were not followed by significant earthquakes. This project has been recessed because of budget restrictions. It could be resumed in the future.

Microacoustic emissions. Microacoustic survey stations (to detect high-frequency emissions in the earth's crust that may occur prior to an

earthquake) were maintained at five sites between Palmdale and Parkfield along the San Andreas fault, and monitored by the Division on a monthly schedule. The sites extend across most of the Valyermo to Cholame valley segment of the fault, which has remained "locked" since the 1857 Fort Tejon earthquake. A general quieting of background acoustic emissions beginning in early 1976 and continuing, with minor fluctuations, that was detected is not thoroughly understood, although a possible explanation was suggested by certain laboratory acoustic emission experiments in which a general decrease in emission was observed before the final burst of activity leading to failure. No sudden or "final" increase of activity similar to that observed in the laboratory experiments has been noted in our field studies. This project has been recessed because of budget restrictions and could be resumed in the future.

Tiltmeter program. The Division has the capability to measure tilting of the earth which may occur as a precursory effect to earthquakes and to volcanic activity. Earthquake precursory tilting effects have been observed on Division tiltmeters in the Parkfield area in January 1975 and in April-May 1976. The Division's tiltmeter program, to measure tilting in relation to earthquake activity, has been recessed in the Parkfield-Cholame Valley region of the San Andreas fault because of budgetary restrictions.

III. Minerals Program

The State recognizes the importance of mineral resources to our highly industrialized society, and the need to identify domestic mineral resources that may of necessity be relied upon to maintain our society in the years ahead. The Division of Mines and Geology is therefore carrying out a multidisciplinary program to secure fundamental information that is necessary to identify the extent, nature, and magnitude of the mineral resource potential of the state.

The mineral needs of the future will be met by mining from surface and near-surface high grade and low grade deposits, deep-seated high grade domestic deposits, offshore deposits, and foreign deposits. The recycling of metals and the use of substitute materials for metals will be accelerated to obviate the need for some mining. Until now, our society has greatly benefited by being able to mine the easy to find, high-grade surface and near-surface deposits. To prepare to meet future needs, it is essential to direct investigations into the lower grade surface deposits, the deep-seated high grade deposits, and the offshore deposits.

Some mineral materials are present in great abundance near the surface, and based upon expected demands can be made available in adequate quantities long into the foreseeable future by proper management of the resource areas. The Surface Mining and Reclamation Act of 1975 as amended provides the governmental mechanism by which known mineral resource areas can be managed to insure their continued availability for mineral extraction. Other mineral materials are relatively scarce or unevenly distributed at the earth's surface. As part of a long term strategy to ensure a continuing supply of the relatively scarce minerals, it is imperative that some of the wealth generated over the years from the high-grade surficial mineral deposits be utilized to identify areas where minerals may be obtained in the future.

The task of identifying possible future sources of minerals is a joint responsibility of the mineral industry, academic researchers, federal geological and mining agencies, and state geological surveys such as the California Division of Mines and Geology. Each type of organization provides unique contributions to meeting the challenge of ensuring that there be a continuing supply of mineral material.

The Division of Mines and Geology's multi-disciplinary program to secure fundamental information regarding the mineral resource potential of the State provides for the following activities:

1. Inventorying of mineral deposits.
2. Monitoring of mining activity.
3. Classification of the land for mineral content and potential.
4. Providing a source of information, a library, a mineral exhibit, and trained staff for consultation.
5. Publication of reports of investigation concerning mineral resources.
6. Regional geologic mapping and compilation of rock-stratigraphic and rock-structure information.
7. Regional Bouger gravity-anomally map preparation and interpretation.
8. Regional aeromagnetic map compilation.

9. Regional stream-sediment geochemical anomaly investigations.
10. Integration of the various types of information and interpretations noted above with modern concepts of plate tectonics and ore deposition to develop a basis for mineral favorability determinations and mineral-land classification.

The need to integrate knowledge derived by various sophisticated lines of investigation can be appreciated when we consider the extreme complexity of that part of the Earth's crust now occupied by California. This complexity of the crust is attributable to California's position at the edge of the continent where plates of the crust have come in juxtaposition, where subduction and continental accretion have occurred, where plutonism, volcanism, and hydrothermal alteration have occurred, and where considerable other related tectonic activity is still occurring as a consequence of adjustment to the convergence of mobile plates. The complexity of the evolution of California's terrain is responsible for the diversity of California's resources (including its mineral resources) and its scenic features. California is and will continue to be the source of a great number of mineral commodities. The state is an important source of highly valuable and relatively rare mineral commodities and it could become the source of other rare mineral commodities. To fulfill this promise, it is essential for the Division to continue to provide the information needed to permit the management of lands favorable for the occurrence of minerals in such a way that minerals may be extracted when needed.

1. Mineral land classification and reclamation

The continued availability of mineral resources that are critical to California's economy and the reclamation of mined lands are the twin and interrelated objectives of the Surface Mining and Reclamation Act of 1975 (SMARA). These objectives are reached through land-use planning and regulatory programs administered by local government in cooperation with the State. The California Department of Conservation, the Division of Mines and Geology, and the State Mining and Geology Board are the State agencies responsible for administering this program.

Three interrelated programs within the Division have been established to implement the goals of SMARA. These are the Urban SMARA, Country SMARA, and Mined Land Reclamation programs. These programs are a cost-effective way to assure that California's mining industry, which produces nearly $2 billion of annual mineral value, continues to provide society with needed mineral commodities in an environmentally sensitive manner.

a. Urban SMARA Program

The Urban SMARA Program's mineral resource conservation objective is achieved through a mineral inventory and economic assessment process termed "classification-designation," which jointly involves the Division and the Board, and a land-use planning activity involving local government. Information on the location of important mineral deposits is developed by the Division through the process of mineral-land classification. This information is used by the Board in designating those deposits which are of economic significance to a region, the state, or the nation. Local government uses this information in developing mineral resource management

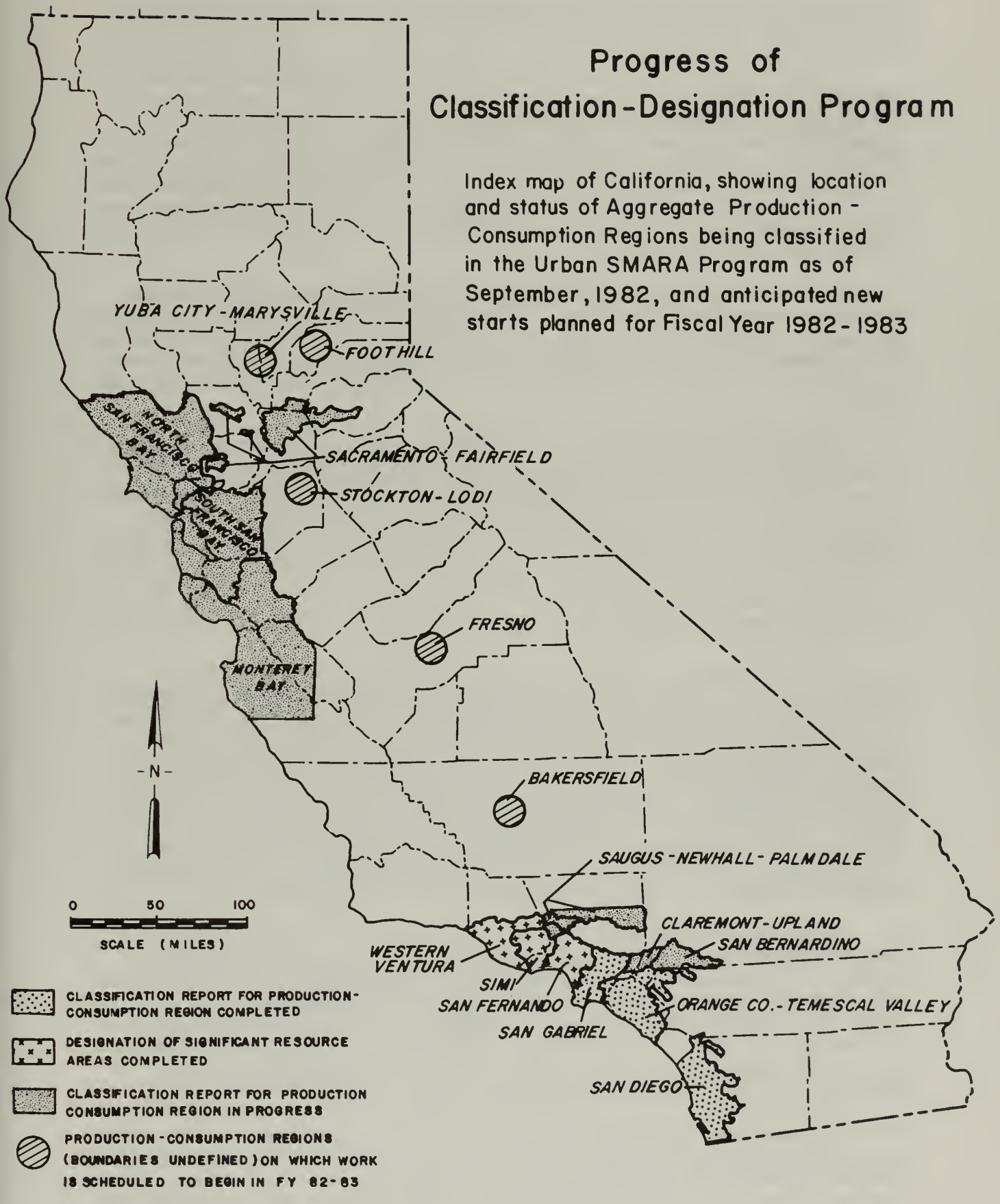
Progress of
Classification-Designation Program
Index map of California, showing location and status of Aggregate Production - Consumption Regions being classified in the Urban SMARA Program as of September, 1982, and anticipated new starts planned for Fiscal Year 1982-1983
YUBA CITY-MARYSVILLE
FOOTHILL
NORTH SAN FRANCISCO BAY
SACRAMENTO-FAIRFIELD
STOCKTON-LODI
SOUTH SAN FRANCISCO BAY
FRESNO
MONTEREY BAY
BAKERSFIELD
SAUGUS-NEWHALL-PALMDALE
CLAREMONT-UPLAND
SAN BERNARDINO
WESTERN VENTURA
SIMI
SAN FERNANDO
SAN GABRIEL
ORANGE CO.-TEMESCAL VALLEY
SAN DIEGO
-N-
0 50 100
SCALE (MILES)
CLASSIFICATION REPORT FOR PRODUCTION-CONSUMPTION REGION COMPLETED
DESIGNATION OF SIGNIFICANT RESOURCE AREAS COMPLETED
CLASSIFICATION REPORT FOR PRODUCTION CONSUMPTION REGION IN PROGRESS
PRODUCTION-CONSUMPTION REGIONS (BOUNDARIES UNDEFINED) ON WHICH WORK IS SCHEDULED TO BEGIN IN FY 82-83

Figure 6. Progress of the Urban SMARA Classification-Designation Program, June 30, 1982.

policies and in making land-use decisions to assure the conservation and development of these resources

Classification. Currently, the Division is identifying important construction-quality sand and gravel deposits in the Los Angeles, San Francisco, and San Diego metropolitan areas under its urban area classification program. Thirteen different areas are currently being studied in and adjacent to the metropolitan centers of the state. Three of these areas (called production-consumption regions) were completed and published by the end of fiscal year 1981-82. These included the San Fernando Valley, Ventura (western Ventura and Simi Valley) and Orange County-Temescal Valley.

Two production-consumption regions, San Gabriel Valley and western San Diego County, were finished, but publication had not been completed by the end of the fiscal year. The eight remaining areas under study during fiscal years 1980-1981 and 1981-1982 are in various states of completion. The status of progress in the Urban SMARA Program is shown graphically in Figure 6.

Designation. Designation of classified sand and gravel resources in urban areas is underway. Designation of regionally significant mineral resources in the San Fernando Valley, the Simi Valley and western Ventura County regions has been completed. Currently, designation in the San Gabriel Valley and in the Orange County-Temescal Valley regions, is under consideration.

b. Country SMARA Program

As authorized by the Surface Mining and reclamation Act of 1975 (SMARA) and Senate Bill 1300, the State Mining and Geology Board passed a resolution in March 1981 directing the Division to undertake mineral land classification studies within the Foothill region of the Sierra Nevada Mountains and the California Desert Area. These areas contain mineral resources of regional or statewide significance that could be adversely affected by land use decisions that would preclude mining from such places. The State Mining and Geology Board set priority for the classification in which studies would begin in the foothills portion of the Sacramento 1° X 2° quadrangle and in the Kingman 1° X 2° quadrangle which is a part of the California Desert Conservation Area.

The program was immediately activated upon receiving an order of priority for classification and each project area was structured into 3 phases: (1) Assembling and evaluating existing geologic, geophysical and mine data pertaining to the area; (2) Undertaking geologic field investigations, mine examinations and conducting geochemical surveys; and (3) Preparation of a geologic report and mineral resource classification map of the area based upon a synthesis and analysis of data gathered during phase I and phase II of the program.

The area represented by the Placerville 15' quadrangle portion of the Sacramento sheet was chosen as the "pilot area" in which to begin the non-urban SMARA classification program. At the close of the fiscal year 1980-81, Phase I of the Placerville 15' quadrangle had been completed and Phase II was in progress.

The area represented by the Old Dad Mountain 15' quadrangle portion of the Kingman sheet was chosen as the area to begin classification within the California desert. At the close of fiscal year 1980-81, Phase I of this project had been completed.

During the first quarter of fiscal year 1981-82, the Placerville 15' "pilot area" report was completed and presented to the State Mining and Geology Board. It was subsequently released to the public as an open-file report by the Division (OFR 82-1 SAC). Substantial interest was shown in the report as evidenced by the considerable number of copies sold to the public, major and small mining companies, academicians, and other users, as well as by requests for it from land-use planners.

Country SMARA land classification field activity continued during fiscal year 1981-82 in the foothill portion of the Sierra Nevada mountains in a 250 square mile area within Amador County. Similar work was in progress in the California desert south of Baker in an area encompassing about 500 square miles.

At the request of the Mining and Geology Board, CDMG staff completed mineral land classification studies in 3 areas located in southern California which contain mineral resources of significance that had been petitioned for classification by outside interests.

Although the Country SMARA classification program has just started, considerable interest has been shown by several groups for this activity. Staff geologists assigned to the program have received numerous inquiries from local governments as well as the private sector about the scope of the program and the availability of the results of the investigations.

c. Mined Land Reclamation Program

During fiscal year 1980-81, the Division continued to review mine reclamation plans in accordance with the guidelines of the State Mining and Geology Board published in April 1977. Division staff visits all proposed mining operations in addition to reviewing the reclamation plans submitted. The basic assignment of the staff is to be continually aware of any problems in the application of the state's guidelines on reclamation plans so that the State Mining and Geology Board can act on such information in order to adequately implement the Surface Mining and Reclamation Act.

During fiscal years 1980-81 and 1981-82, the Division staff completed the preparation of the "Proceedings of the Mined Land Reclamation Workshop." The workshop itself was held at the University of California at Davis in June 1979. Final prepared copy of the "Proceedings" was sent to the Office of the State Printer for printing in February 1982.

The passage of Senate Bill, SB 1300, during fiscal year 1980-81 required the Division to increase its activities on the review of reclamation plans. As a result, a new reclamation unit was organized and staffed with a variety of technical expertise including revegetation and erosion control. This new unit began work as a separate program entity in fiscal year 1981-82.

The Division formed the multi-disciplinary reclamation staff with expertise in engineering geology, erosion control, plant ecology, wildlife biology and environmental planning in the last part of fiscal 1980-81. The staff has responsibility for reviewing mine reclamation plans for lead agencies, in accordance with the Surface Mining and Reclamation Act of 1975, and disseminating information on reclamation to lead agencies, the mining industry, and the public. Staff prepared an article explaining the reclamation program for the March 1982 issue of California Geology.

Technical assistance and site consultations. As reclamation advisors to lead agencies, the staff reviewed over 257 reclamation documents during fiscal 1981-82. Each member of the staff participates in the review by providing specific expertise, and interacting in the review of problem areas. Many reviews include requests to participate in on-site reviews. Staff visited 77 mine sites in fiscal 1981-82 (some visits were part of program orientation activities). Many site reviews were conducted with other State agencies such as the Water Quality Control Boards and the Department of Fish and Game.

Participation in advisory committees on regional/technical issues. In several areas of the State, reclamation plans are being reviewed which effect a watershed, or which encompass more than one political entity. Increased cost effectiveness and efficiency can be achieved when all concerned parties review and analyse projects in a regional context. Reclamation staff participated in Sonoma County's Ad Hoc Committee for the review of reclamation along the Russian River; Napa, Lake, and Yolo counties' coordination meetings for Homestake's McLaughlin Project; and the Lahontan Regional Water Quality Control Board's Leviathan Mine Reclamation, Technical Advisory Committee.

Surface mined-land reclamation in California: planning and practices. Staff is preparing a publication on reclamation planning and practices in order to provide the mining industry, lead agencies, and the public with information on the planning process, subsequent land uses, landshaping and erosion control, revegetation, and performance assurance. An annotated bibliography and glossary will also be part of the publication. Mines which are presently using good reclamation practices will be showcased in the publication. The publication should be completed in fiscal year 1982-83.

Reclamation plan repository. Staff is assembling reclamation plans for mining operations throughout the state. The plans are on file by county in the CDMG Bercut Office in Sacramento. Approximately 75 percent of all reclamation plans were obtained in fiscal year 1981-82. The plans are being entered into the SMARA/Minerals Computer Index system. A computer listing for each plan should be available in fiscal year 1982-83. Locations of mines with reclamation plans are being plotted on county maps, and will also be available on computerized maps in fiscal year 1982-83.

Revision of the Model Reclamation Plan. The Model Reclamation Plan was prepared in 1976 as part of the Division's Special Publication 51. Based on the experience gained in reviewing reclamation plans, the staff has redrafted the Model Reclamation Plan to make it a more valuable tool

for reclamation planning for both lead agencies and the mining industry. It was submitted to the State Mining and Geology Board in fiscal year 1981-82, and will receive public review in fiscal year 1982-83.

2. Mineral commodity investigations

A uranium study funded through the Bendix Field Engineering Corporation by the U.S. Department of Energy and completed during fiscal year 1979-80 by Marjorie M. Bushnell and Paul K. Morton is being processed for publication as a CDMG Special Report. The title is "Uranium Resource Evaluation, Trona Quadrangle, California."

3. Public information functions

Besides response to public inquiries, the Minerals Program staff were engaged in maintaining, gathering and reporting inventory data on active mining operations and new exploratory activities. Another important function is responding to federal and local land-use planning reports that impact on mineral resource lands.

4. Federal land-use programs coordination

Two acts of Congress, the National Forest Management Act of 1976 and the Federal Land Policy and Management Act of 1976, require the Federal Government to prepare major land-use and resource management plans for the national forests and the BLM-administered public lands of the United States. In California, the Federal lands constitute about 45 percent of the land area of the State. The State is concerned about the outcome of these land-use programs, and their effect on the uses and access to resources of these public lands. CDMG is specifically concerned about access to the mineral resources of the public lands.

CDMG is also concerned about other Federal government actions that may affect the availability and utilization of California's mineral resources, such as proposed changes in the U.S. Mining Law, proposals for national parks or wildlife refuges that would exclude mineral development, or the development of surface-use regulations that would present technical or economic barriers to mineral development.

The principal tasks under this minerals program activity are:

a. Monitor the Federal land-use programs and other Federal actions that have impacts on mining, and keep the Department of Conservation and others informed of those activities.

b. Maintain liaison with the various governmental agencies and non-governmental organizations that are involved in land-use planning processes or minerals-related actions.

c. Provide assistance to other agencies and organizations, in the form of minerals-related information or expertise.

d. Provide critical review of various proposed Federal land-use plans, environmental impact statements, proposed legislation, and proposed regulations.

Under this minerals program activity during the 1980-81 and 1981-82 fiscal years, CDMG:

a. Reviewed various pieces of proposed Federal legislation, proposed Federal regulations, and prepared critical commentary.

b. Prepared a report for the Department of Conservation on the factors pertinent to the establishment of a State minerals policy.

5. Geothermal resources studies

The Division has completed its third year (1980-81) and is nearing completion of its fourth year (1981-82) of low- and moderate-temperature, geothermal resource assessment studies under sponsorship of the federal Department of Energy (DOE), state-coupled program. California is one of 15 western states involved in these independent studies to assess this underdeveloped resource.

The main efforts in the third and fourth years have been fourfold: (a) Phase I Studies that include reconnaissance level geothermal assessment of 40 Sites scattered throughout the state; (b) a concentrated Phase II study of the low- and moderate-temperature geothermal resources of the San Bernardino area in San Bernardino City and County; (c) assessment of the geothermal potential of heated brines, produced as an unwanted by-product in oil field operations in Los Angeles County; and (d) preparation of data for a geothermal scientific map of the state. For the fourth year, the studies have included: (a) a second set of reconnaissance level assessments of 40 sites scattered throughout the state; (b) concentrated Phase II studies of the low- and moderate-temperature geothermal resources of Sonoma Valley in Sonoma County; (c) completion of previously begun Phase II studies in Bridgeport, Mono County, and Paso Robles, San Luis Obispo County; and (d) printing of the technical map after cartographic preparation by NOAA.

Phase I studies. Phase I work involved, for the third year, developing a set of criteria for site selection, and for both years, the selecting of 40 sites with potential for geothermal development, plus 20 alternate sites; researching and visiting each site, including water sample collection and analyses; and writing a short report, suitable for publication for each of the sites. An open-file report was prepared for the third year sites studies, and as of late June 1982, all of the chosen sites for the fourth year had been visited and reports were in preparation.

Third year Phase II studies. For Phase II studies of low- and moderate-temperature geothermal resources, under the third year contract, the San Bernardino area was chosen. Reasons behind choice of this site include, but are not limited to: moderately widespread occurrence of geothermal surface indicators; a large labor, agricultural, and industrial marketplace; excellent transportation; and interest in the part of local government and the private sector in geothermal resource development.

Data gathering, map compilations, and related geophysical and geologic studies have been diligently pursued by CDMG in the San Bernardino study area. Final geological and geophysical field studies have been performed including resistivity, magnetic, and gravity surveys, and a geothermal well sampling and temperature probe survey. In addition, much new data has been collected from other sources and compiled on CDMG's new gravity and geologic maps of the area. Final report preparation for the San Bernardino study is in progress.

During the course of this study, CDMG has cooperated with local government and has provided information on its findings. As a partial outgrowth, plans are underway between the California Energy Commission (CEC) and the city water department to drill and test up to three geothermal wells to provide energy for the sewage digesters in a city owned water treatment facility. CMDG will act as advisor and consultant to the city and CEC in this matter. It is expected that a large savings in natural gas purchases will result.

As part of its studies under the third year contract, in Los Angeles County, the Divison has undertaken an extensive investigation of hot waters, produced as by-products in oil field operations, which may have a potential for geothermal energy applications. Detailed data search of California Division of Oil and Gas (CDOG) records, to identify anomalously high temperature oil and gas zones has been performed. Much new information has been obtained and is currently being analyzed for bottom hole temperatures and is being compiled on maps of the Los Angeles County area to show zones of high temperature brine production. Responses were received to over half of a group of questionnaires sent to 40 operators of petroleum facilities handling geothermal brines in the Los Angeles area. Much information collected in this manner would not be available from other sources; responses so far have ranged from very negative to very positive with respect to the idea of use of the heat from the produced brines as a separate resource. Some operators explain that the heat is needed for reinjection to the producing zone to maintain petroleum viscocity; others have a problem disposing of excess heat from produced waters. It appears that by matching potential industrial and agricultural users of the waste geothermal energy with petroleum facilities where it is produced, it will be possible to achieve a substantial savings in the use of fossil fuels.

Fourth year Phase II studies. The major Phase II study area chosen for work under the fourth year contract (1981-82) was the southern Sonoma Valley, in Sonoma County. Reasons for choice of this study site included, but were not limited to: moderately widespread occurrence of geothermal resource indicators; close proximity to a large labor, agricultural, and industrial market place (Santa Rosa and the San Francisco Bay area); good transportation facilities; and interest on the part of local government and the private sector in geothermal resource assessment and development. Data gathering, map compilations, and related geological and geophysical field studies performed included an extensive geothermal well sampling and temperature probe survey, resistivity, seismic refraction, magnetic, and gravity surveys, geohydrology studies, and reconnaissance geologic mapping. Also included was a study of the seismicity of the area as it relates to geothermal occurrence. Field work has been completed and a major report for the study is in preparation.

Two other Phase II studies, one at Bridgeport in Mono County and the other at Paso Robles in San Luis Obispo County, were also undertaken as part of the work under the fourth year contract. Both areas had been the subject of preliminary studies by CDMG in previous years but important geophysical studies and final development of the geological and hydrogeothermal pictures for each remained to be done. Much of this work is now either complete or nearing completion, and a major final report for each area is in preparation. Both areas have a high potential for geothermal resource development and use, and the municipal governments in each case have become interested in developing the resource for district heating and related uses.

Technical geothermal map. The Division, in cooperation with NOAA, in 1980 published a map titled "Geothermal Resources of California." The map shows, at a scale of 1:750,000, the distribution of the known low-and moderate-temperature geothermal resources of California. A second or scientific map of the State's geothermal resources is in preparation and will show, also at a scale of 1:750,000, scientific information, particularly regarding geochemistry geology and faults, relative to the known geothermal occurrences throughout the state. Tables listing all of the chemistry data for presentation on the map are nearly completed and geothermometry data are being calculated through a joint effort with USGS, Menlo Park. A map on a mylar base has been prepared to show the geologic units and faults that are to be presented on the final Scientific Map. Also completed are two insert maps, one showing contours of ambient air temperature and the other of groundwater temperatures throughout the State. Cartographic preparation will be performed by NOAA and printing, expected in early 1982, will be performed under subcontract by CDMG, all under the sponsorship of DOE.

Geothermal test drilling. A final segment of the 1979-80 CDMG Calistoga study, geothermal test drilling, was performed from December 1980 to February 1981. A report has been prepared and is being readied for distribution. Three holes were drilled to depths ranging from 206 to 885 feet. The previously unsuspected existance of seven individual aquifers in the vertical section at Calistoga was disclosed by the drilling effort, and testing, sampling, and analyses were completed for each aquifer. Data from CDMG's Calistoga geothermal studies are being used in the design of a geothermal production drilling program for major motel-spa complex to be built in Calistoga.

California Energy Commission studies. In addition to the DOE sponsored geothermal studies, the Division began field work in July 1981, under terms of a contract signed with the California Engergy Commission, to perform geophysical studies at approximately three sites within the state to select areas with potential for geothermal development drilling. The first site is the Rohnert Park-Sonoma State College area where geophysical information has shown that a subsurface trend of volcanic rocks, with associated geothermal waters, may extend beneath the campus. The geothermal resource could be used for space heating on campus.

The two other sites chosen for this study include the Sonoma State Hospital vicinity and the Santa Rosa vicinity. Geophysical data developed by CDMG at Sonoma State Hospital showed a strong correlation between a buried fault and geothermal occurrence in the area, and these data were considered in designing a private venture geothermal drilling program that proposes to sell energy to the Hospital when drilling is completed. In the Santa Rosa area the

association of geothermal occurrence with buried faults was also noted. Information developed also suggests that host rocks for geothermal fluids may be buried (and fractured) Sonoma Volcanic rocks. Sonoma County, with administration facilities located in Santa Rosa, is interested in working with CDMG to see whether geothermal energy can be developed to provide for heating of the county facilities.

IV. Basic Geology Program

The Division's basic geology program conducts activities that are fundamental to the development of mineral resources information, to the application of engineering geology concepts to land-use decisions, and to general land-use analyses. The basic objective of the program is to understand and describe the distribution and physical properties of rocks so that the state may advise in matters concerning the geology of any part of the state.

Within this general program, the Division has undertaken: (1) regional geologic mapping; (2) aerial geologic mapping; (3) geochemical support; (4) subsurface data collection; and (5) preparation of indexes to basic geologic mapping.

1. Regional geologic mapping

A new series of regional geologic maps was initiated in 1978 because most State Atlas sheets were more than 15-20 years old and considerable new geologic mapping had been accomplished since they were published. These new 1:250,000 scale maps take into account major geologic concepts developed in recent years, such as plate tectonics, and depict, for example, the Coast Range thrust, ophiolites, and melanges, not specifically recognized and shown on the old series. An entirely new format has been developed, which adheres more closely to modern stratigraphic concepts. Each map has its own geologic legend, wherein geologic formations are identified where possible rather than grouping them by units of time as in previous editions. Also, much more structural data are shown -- not only faults, but folds, and attitudes of stratified and metamorphic rocks.

The pilot map in this new 1:250,000 scale Regional Map Series is the Sacramento quadrangle. More than 75% of map data used is new, i.e., completed since the earlier (1965) edition was published. Melange concepts concerning the Sierra Nevada Foothills belt were utilized in the new compilation and interpretation of the earlier data. Extensive upgrading of approximately ten 15' quadrangles in the higher parts of the Sierra was undertaken by Division staff where the only geologic data available were the U.S. Geological Survey Folio maps surveyed in the 1890's (see Figure 7).

The new Sacramento quadrangle map is Map No 1A of the Regional Map Series. Four sheets have been prepared to show the geologic and related data. The first sheet is a colored lithographed geologic map with an abbreviated legend and a representative cross section across the entire map. Sheet 2 consists of the complete geologic map explanation and is also in color. Sheet 3 is a detailed index to the maps used to compile the geologic map, and Sheet 4 is a location map and chart describing rocks that have been dated by radiometric methods.

The second Regional Geologic Map of this new series will be the Santa Rosa quadrangle. This area, which lies due west of and contiguous to the Sacramento quadrangle, extends from the westernmost part of the Great Valley province across the Coast Range province, and includes a significant area

offshore. A geologic legend of 64 formational rock units has been devised. The area is underlain primarily by of Franciscan rocks, strata of the Mesozoic Great Valley Sequence, and Tertiary Sonoma Volcanics.

The original Santa Rosa geologic atlas sheet was published in 1963. During the past 17 years, considerable new data have been amassed which will be used in the new compilation. Areas where geologic mapping was lacking or inadequate lie in the northwestern and northeastern parts of the quadrangle, and field mapping by the Division to upgrade these areas was undertaken.

On the 1963 Santa Rosa sheet geologic information was not available on the offshore area. On the new edition, considerable structural data including faults and folds are now shown. Also, a large body of new data for radiometrically dated rocks, especially for the young volcanic rocks of the Clear Lake-Sonoma Mountains area, are plotted on an accompanying sheet.

This section of the Coast Ranges is laced with a large number of active and potentially active faults, such as the San Andreas, Rodgers, Creek-Healdsburg, Maacama, Green Valley, Collayami, and other related faults. This area of badly broken rocks naturally has a propensity for sliding and the new map, therefore, shows areas where larger landslides occur.

Potential mineral resources evaluation will benefit by this synthesis of geologic data showing host rock and structure relationships pertinent to an understanding of ore deposition. Such data should be useful in exploring for concealed deposits as well as planning programs under the Surface Mining and Reclamation Act (SMARA).

This quadrangle, like the Sacramento quadrangle, will comprise several sheets. These will include: (1) a colored geologic map and cross sections; (2) a source data index sheet; (3) a detailed geologic legend; (4) a sheet showing both the location of rocks that have abeen dated by radiometric methods, and the location of thermal springs and wells; and (5) a map focusing on faults occurring in the area distinguishing them by means of different colors as to recency of activity. The topographic base on which the former Santa Rosa atlas sheet was published is now 22 years out-of-date. Updating the geology on a more modern topographic base will make the map much more useful, and will, enable one to locate and relate the geology and faults more accurately and quickly. Scribing and preparation of the printer's plates were being done during fiscal year 1981-82. The quadrangle is expected to be printed during fiscal year 1982-83.

A new San Bernardino quadrangle is being prepared by Thomas Spittler and Edward Bortugno. It will include significant new data from seven projects supported by the Data Base Augmentation Program. Since the earlier San Bernardino map was published, considerable new information has been generated for this area and the compilation is very timely considering the great deal of structural and stratigraphic work currently going on in the Mojave Desert. The recent recognition and correlation of Great Basin stratigraphy in this area will be portrayed by the new geologic legend especially designed for this sheet and will include some 79 formational units, compared to the 54 State Map Sheet units portrayed on the earlier edition.

The Weed quadrangle in northern California is being prepared by David Wagner and George Saucedo. The earlier map published in 1964 and based largely on rapid reconnaissance, will be revised radically. During the past 17 years, a great wealth of new mapping has been acquired and this is being supplemented by 10 projects supported under the Data Base Augmentation Program, the work of five experienced volunteers (including three professors), the culmination of several years of U.S. Geological Survey work in wilderness areas, and the detailed reconnaissance mapping done by the Regional Geologic Mapping staff. Work to date has revealed several surprises even in the gross distribution of the principal rock types -- e.g., missing plutons and nonexistent ultramafic sheets.

The Regional Mapping Program of the Division is managed by Charles Jennings with the assistance, during the fiscal year, by David Wagner, Edward Bortugno, Thomas Spittler, George Saucedo, Drew Smith, and Fred Kelley. A five-year plan for preparation of 1:250,000 scale map sheets was devised and later approved by the Department. A graphic display of the sheets completed, underway, and proposed is shown in Figure 7.

2. Areal geologic mapping

Geologic mapping is basic to every program of the CDMG. Where existing map data are lacking or inadequate for a program's purpose, mapping is undertaken by Division staff, whether this be for environmental geology investigations, fault hazard evaluation, mineral evaluation, or completion of regional geologic maps.

a. Data Base Augmentation Program

Recently, a new Data Base Augmentation Program (DBAP) was instituted by use of graduate students and professors to acquire basic geologic mapping in critical areas of the state, especially in areas where new regional maps are being prepared by the staff. During the first year of the program (fiscal year 1980-81), 40 proposals were submitted of which 28 contracts were made for the study and mapping of 3100 square miles of the state. Figure 8 shows the locations of these mapping projects within California.

Funding for DBAP is from the Energy Resources Fund (ERF)--revenues derived from the State's oil and gas leases. This program was directed during fiscal year 1980-81 by Drew Smith, Gene Saucedo, and Charles Jennings with assistance from the Regional Geologic Mapping staff. CDMG supplied aerial photography and mylar base maps to the contractors. The Regional Geologic Mapping staff provided assistance to students, and most projects were checked in the field by staff members. Approximately $75,000 in contracts were let during the first year of the Data Base Augmentation Program.

The use of the Energy and Resources Fund monies for this program is proving to be an unusually cost-effective way of rapidly acquiring the kind of regional geologic data base that is needed for this state. Having this kind of data base is critical to identifying the energy and

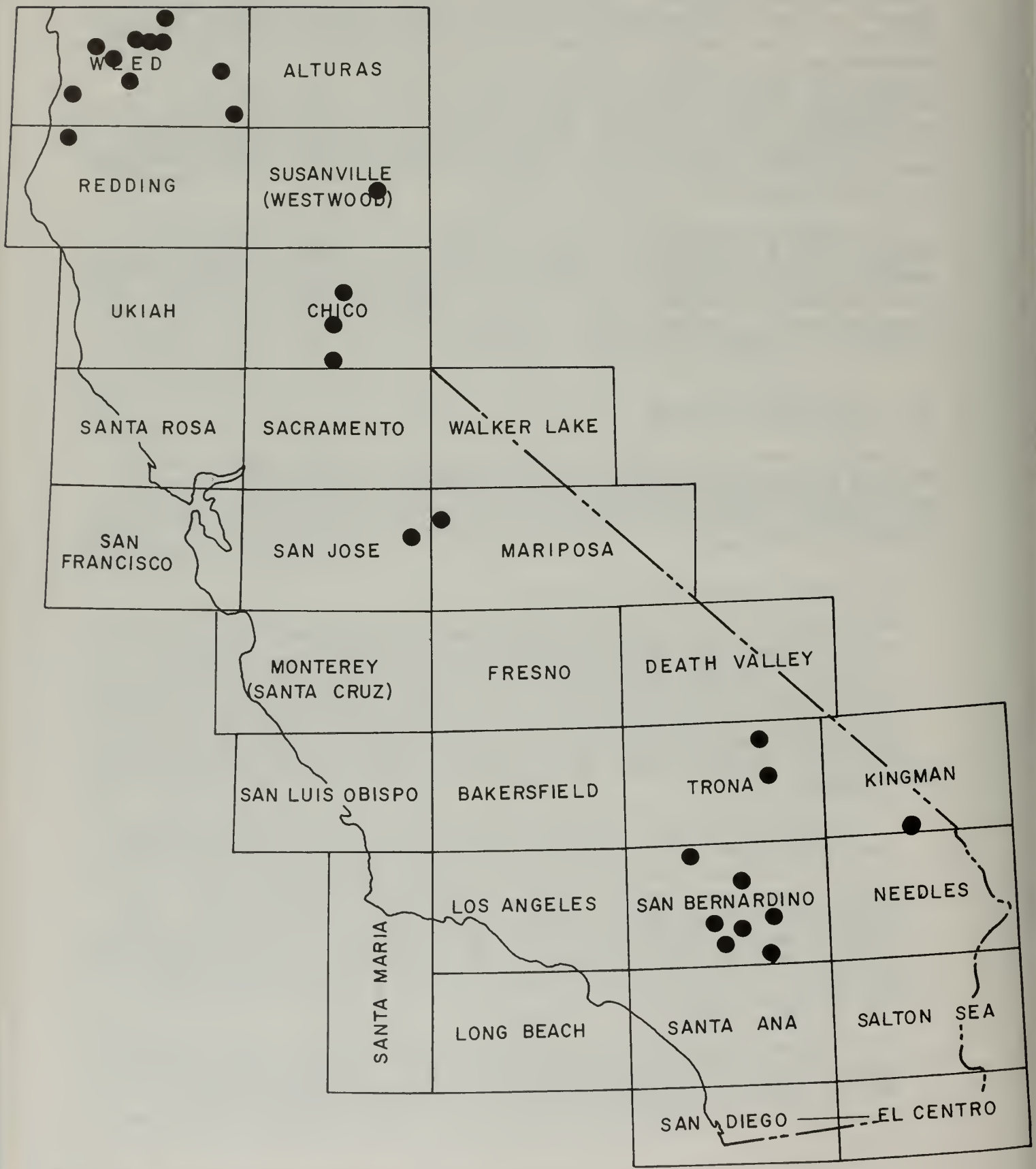

Figure 7. Status of the Regional Geologic Mapping Program's five-year plan, June 30, 1982.

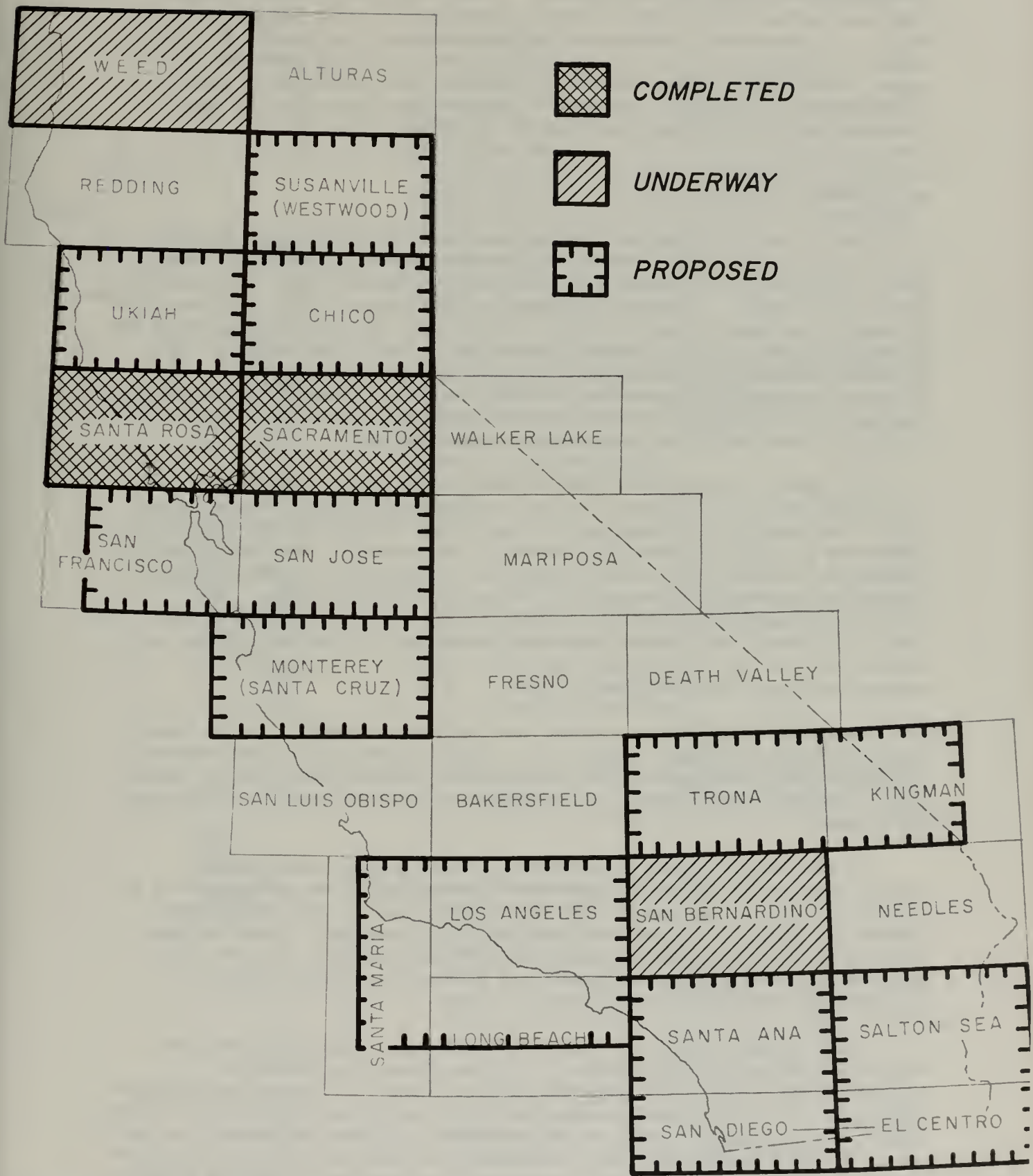

Figure 8. Locations of mapping projects, Data Base Augmentation Program, June 30, 1981.

mineral resources of California, and for gaining a better understanding of the state's geologic environment. These detailed student geologic maps are being acquired at a cost to the state of about $32.00 per square mile. By comparison, equivalent geologic mapping, performed by state or federal professional geologists, costs between $100 and $200 per square mile. All of the student work is contracted on a competitive basis, and the principal selection criterion is that the geologic mapping must be conducted within the geographic areas of highest priority.

b. COSUNA

This acronym stands for the Correlation of Stratigraphic Units of North America, a project started by Professor Orlo E. Childs of Texas Tech. University and sponsored by the American Association of Petroleum Geologists (AAPG). The main objective of the project is to publish a set or sets of columnar stratigraphic sections that are representative of the geology within the many geologic provinces of the United States. The California Division of Mines and Geology has been involved in coordinating the California part of this project. James F. Davis, State Geologist, Sacramento, and Charles C. Bishop, Geologist, San Francisco District, were named California Region Coordinators.

The general format will follow that of the charts published by the Geological Survey of Canada as a part of Economic Geology Report No. 1, 1970. For purposes of compilation, the United States was divided into a number of geologic provinces as shown on the Geologic Code Map of AAPG's Committee on Statistics of Drilling. The stratigraphic sections will be grouped by province and these will be combined into regions. The California Region includes most of California and that part of Oregon that lies within the Klamath Mountains province, but excludes Modoc and Lassen counties as well as Mono and Inyo counties, all of which lie within the Great Basin Region.

The AAPG-CSD Code map divides the California Region into 14 onshore and 3 offshore provinces (Figure 9). County lines rather than natural geomorphic province boundaries were used as the boundaries of the onshore areas in order to accomodate the computer program to which the Code map is linked.

By the end of fiscal year 1981-82, stratigraphic sections representative of all the 14 provinces and one offshore column within the California Region had been received and forwarded to Orlo Childs for review and editing. In all, 88 sections were compiled. These columns will be divided into three sheets, one for the southern, one for the central, and one for the northern part of the state, with about 30 sections on each sheet.

A chrono-stratigraphic chart was developed so that the sections could be correlated and compiled. This was done by a number of paleontologists and stratigraphers familiar with California stratigraphy and expert in the several biostratigraphic disciplines represented on the chart. The Division wishes to extend thanks to these individuals as well as to all who contributed their knowledge and time in the construction of the many stratigraphic columns which were incorporated into this project.

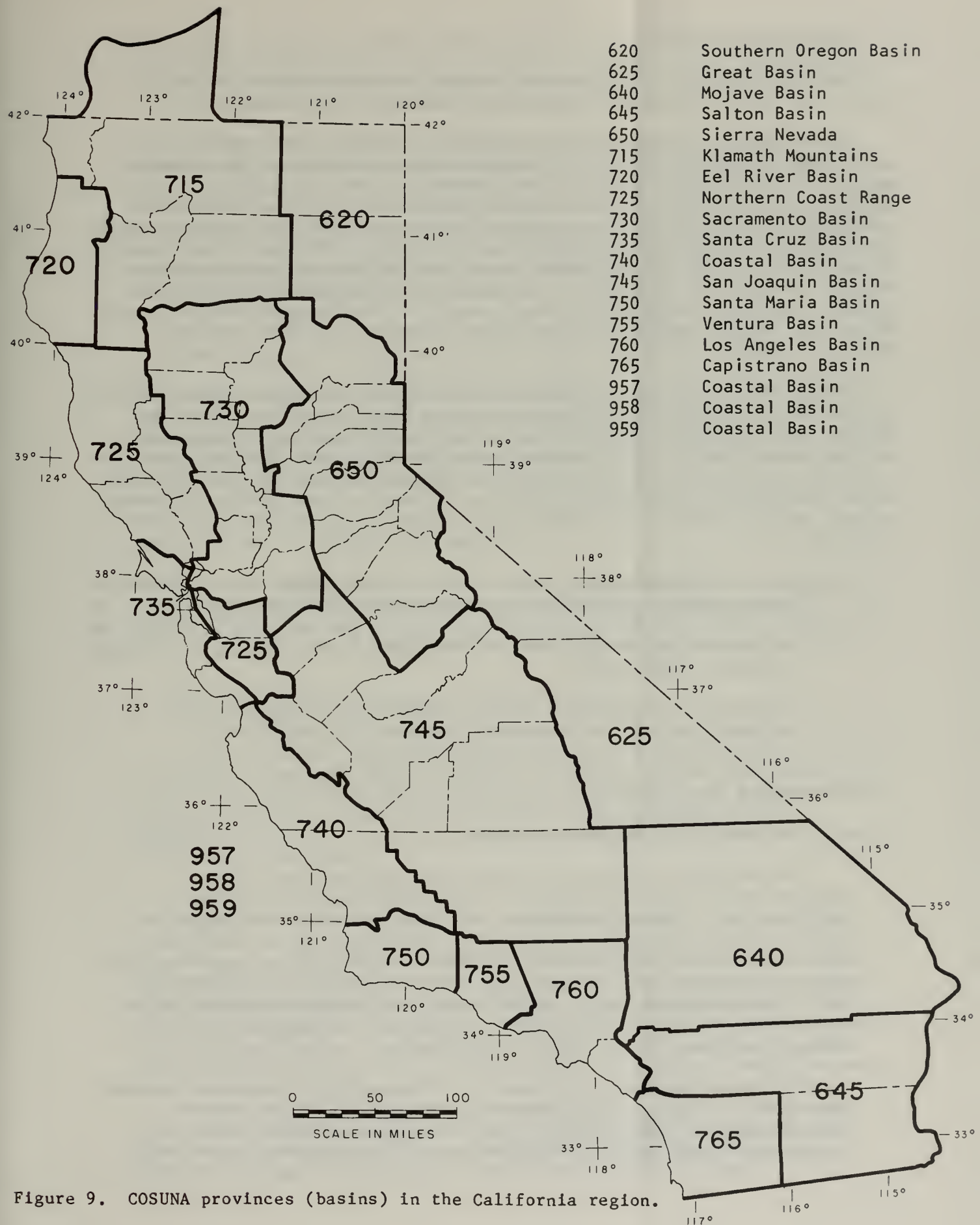

Figure 9. COSUNA provinces (basins) in the California region.

3. Geochemical support

The Geochemical Section provides support to other Division project activities and to independent projects of the geochemical staff.

During fiscal years 1980-81 and 1981-82, a total of 189 samples were processed. Majmundar submitted 24 thermal water samples for the Calistoga drilling project and 40 thermal water samples for the Sonoma Valley geothermal project. Leivas submitted 70 thermal water samples for the 40 sites geothermal study project. Youngs and Bezore submitted 14 thermal water samples from the San Bernardino geothermal project. Corbaley of the Division of Oil and Gas submitted 15 thermal water samples from the Long Beach area. Higgins submitted 2 thermal water samples for the Bridgeport geothermal project. Kilbourne submitted 1 water sample for the Crabtree Springs study. Wagner and Saucedo submitted 23 geological samaples for their regional geological mapping project.

During this period, the findings of Majmundar's environmental/geochemical project on the distribution of heavy elements hazardous to health on the Salinas Valley region were published as California Division of Mines and Geology Special Report 138. Another report by Majmundar, which is currently in review, reports on the geochemistry of thermal waters collected from the three shallow geothermal wells drilled at Calistoga, Napa County. Majmundar is also participating in the preparation of reports on the following three projects:

- Geological/geochemical study of the volcanic rocks in and around the Juniper uranium mine area in the Stanislaus National Forest.
- Geochemical/geothermal study of the thermal waters from the wells of Calistoga, Napa County.
- Compilation, interpretation, and preparation of the text and technical map of the geothermal resources of California.

4. Sub-surface data collection

a. California Well Sample Repository

The Division of Mines and Geology has participated in the establishment, sustaining support, and advisory guidance of the California Well Sample Repository, which is located on the campus of California State College, Bakersfield. The Repository is the first public facility of its kind in California and fulfills a long recognized need to assemble, process, preserve, catalog, and make available for public investigative use, a collection of rock samples representative of the geologic history, stratigraphic sequences, rock properties, and mineral resources of the State of California.

The Repository presently contains cores and ditch samples from more than 8,000 oil and gas wells located throughout the State and its offshore areas. Additionally, other materials available for investigative use include foundation boring samples from various major

engineering projects, examination slides processed for microfauna from over 850 California wells and 214 outcrop localities, and rock-sample material from Division investigations. An annual catalog of the contents of the Repository is distributed upon request.

The Repository is operated by the California State College, Bakersfield, Foundation, with the guidance and support of an Advisory Committee composed of representatives from the petroleum industry, professional scientific societies, institutions of higher education and state government. The Division is represented on the Advisory Committee. Energy and mineral-resources development based on investigative studies of rock materials assembled at this Repository will result in manifold benefits to the people of California.

b. Other sub-surface data collection activities

A wide variety of other Division projects involve the collection of sub-surface data. The most important of these projects during fiscal years 1980-81 and 1981-82 have been seismic ground response investigations, mineral land classification studies (SMARA), and site-review and fault evaluation projects.

5. Indices to basic geologic information

Guides to the literature containing basic geologic mapping is essential not only to work of the Division, but is very useful to others as well. In the past, the Division has prepared and published indexes to areal geologic maps of California and to graduate theses on California geology.

a. Index to published geologic maps of California

Special Report 130 by Edmund Kiessling and David Peterson, published in 1977, was the last complete index to geologic maps of California. It covered the years 1969-1975. Since then, one abbreviated index to 1976 maps was published in the April 1981 issue of California Geology. Because of other priorites and manpower shortages, no systematic indexing is currently under way.

b. Indicies to graduate theses on California geology

Geologic maps contained in Ph.D. dissertations and master's theses are often the most detailed mapping available for various areas of the state. They are especially useful to the Regional Geologic Mapping program. The Division has published two major indexes to graduate theses on California Geology, Special Report 74 and Special Report 115. The latter report, by Gary taylor, was published in 1974 and identifies maps for the years 1962 through 1972. Since then, supplements have been published in our California Geology magazine, the latest in July, 1980. This report listed theses for 1977 and 1978. Incomplete, unpublished files were prepared for 1979 and 1980, but at present, because of manpower shortage, the indexing has not been kept up to date.

c. Bulletin 201

Bulletin 201 is an explanatory text to accompany the fault and geologic maps of California, scale 1:750,000. All reviews of the manuscript for this bulletin were completed during fiscal year 1980-81; production of copy for printing was underway through fiscal year 1981-82; the bulletin is scheduled for release in late fiscal year 1982-83.

The bulletin has three parts, the third of which consists of annotated reference data organized in four appendicies. Appendix A is an index to the 272 fault names shown on the Fault Map of California. In addition, a procedure for the naming of faults that would avoid repetition and confusion is suggested. Appendix B consists of a tabulated list of 584 thermal springs and wells, organized by 1° x 2° State Map Sheet units. This list contains location and temperature data, and pertinent references. For the thermal wells, total depth and year drilled are also given. The location of each thermal spring and well is shown on the index maps to the source data in Appendix D. Appendix C is an index to the over 1,000 geologic formations grouped within the units portrayed on the 1977 Geologic Map of California. Lastly, Appendix D is an extensive index to the source data used to compile the Geologic Map and for classifying the faults on the Fault Map. This index is keyed to 28 maps showing in detail the area covered by the references listed in the bibliographies.

V. Geologic Information Program

1. Publications

Information about the geology, mineral resources, and geologic hazards of California is published by the California Division of Mines and Geology (CDMG) and distributed to professionals and interested lay-persons. The results of studies made by scientific staff members of the Division and others in the earth science professions are published in CALIFORNIA GEOLOGY, the Division's monthly magazine, and in bulletins, special reports, special publications, preliminary reports, map sheets, and geologic maps.

The publications staff reviewed the technical content of manuscripts, edited manuscripts and maps, drafted illustrations and maps, coordinated printing and lithography, negotiated printing contracts, managed the printing budget, and supervised the distribution of the final printed reports. Revenue from the sale of Division publications during fiscal year 1980-81 was $145,000; the amount for fiscal year 1981-82 was $129,000.

News releases concerning the Division's publications are prepared and distributed to the media. Thousands of inquiries received annually by the Division are answered by supplying copies of CDMG Notes, CALIFORNIA GEOLOGY and, when warranted, by individual letter from a member of the technical staff. These activities help to inform the public of the importance of geology to the economy of California.

An information and sales desk is maintained at each District Office.

a. New publications released

Bulletin 205. Interpretation of the gravity map of California and its continental margin. By H.W. Oliver, editor. 52 p. This bulletin is the interpretive text prepared to accompany the gravity map of California (1:750,000 scale). $6.50. The bulletin explains gravity meters used, reduction formulas, accuracies, and conversions to other geodetic systems, and the geologic significance of the major gravity anomalies by provinces.

Special Report 120. Geology for planning in Sonoma County. By M.E. Huffman and C.F. Armstrong. 31 p., 4 tables, 7 figures, 8 plates (6 at scale 1:62,500; 2 at scale 1:250,000). $13.50. This report is a broad overview of the geology of Sonoma County and a county-wide synthesis of geologic hazards information. It is a guide to those areas that are most free of geologic hazards, and those areas where further study is required to determine suitability for the intended use. Specific hazards addressed are earthquake ground shaking and liquefaction potential, surface fault rupture, landslides and slope stability, and tsunamis.

Special Report 138. Distribution of heavy elements hazardous to health, Salinas Valley region, California. By Hasmukhrai H. Majmundar. 57 p., 11 tables, 62 figures. $3.00. This report contains the results of analyses made in the Salinas Valley region. samples of stream sediment and bedrock from the region were analyzed to determine the distribution

and the amounts of potentially health-hazardous heavy elements (arsenic, cadmium, copper, lead, mercury, and zinc). Particular attention is given to the element cadmium, which was found in high levels in the stream sediments and soils in the extreme southeast corner of the project area. Cadmium, traced to relatively thin beds of phosphatic rocks, may occur elsewhere in the United States; thus, it is recommended that other phosphatic rocks be evaluated for possible cadmium contamination.

Special Report 140. Studies of the San Andreas fault zone in northern California. Edited by Robert Streitz and Roger Sherburne. 187 p. $5.00. The sixteen papers collected in this report are by specialists in the earth sciences and engineering. Each paper represents a timely contribution to further the understanding of the San Andreas fault. the papers are grouped under three headings: (1) Geology; (2) Geophysics; and (3) Seismology and Engineering.

Special Report 141. Fault features in soils of the Mehrten formation, Auburn damsite, California. By Glenn Borchardt, Gary Taylor, and Salem Rice. 45 p. 2 tables, 25 figures. $2.50.

Special Report 143, Part III. Classification of sand and gravel resource areas, Orange County-Temescal Valley Production-Consumption Region. By Russell V. Miller and Richard Corbaley. 20 p. This report focuses on the classification of sand and gravel resource areas in the Orange County-Temescal Valley production-consumption region, and includes maps showing the locations of significant sand and gravel deposits and an explanatory text with tables and charts that present data on population, production, aggregate consumption, future requirements, and estimates of aggregate resources.

Special Report 145, Parts I, II, and III. Mineral land classification of Ventura County. By Thomas P. Anderson, Ralph C. Loyd, Edmund W. Kiessling, Susan R. Kohler, Russell V. Miller. 82 p. This report consists of three parts covering two production-consumption regions that have been identified in the Ventura area. Part I is an introductory section describing the background, purpose, and scope of the overall project. Part II presents the classification of aggregate resource areas in the Simi Production-Consumption Region. Part III presents the classification of aggregate resource areas in the Western Ventura County Production-Consumption Region. Information in Parts II and III includes maps showing the locations of significant sand and gravel deposits of the two p-c regions, as well as tables, charts and discussions that present data on population, production, aggregate consumptions, future requirements and estimate of aggregate resources.

Special Report 149. Paleosols overlying the Foothills fault system near Auburn, California. By Glenn Borchardt, Salem Rice, and Gary Taylor. 38 p., 5 tables, 12 figures, 21 photos, 1 appendix. $2.75. The paleosols, overlying the Foothills fault system near Auburn, California, was previously thought to have formed prior to 100,000 B.P. (years before present). the results of this study, however, support an alternative hypothesis: the " Foothills paleosol" was an active soil between 9,000 and 130,000 B.P. Significantly, the overlying "Foothills colluvium" has been carbon-dated at 9,130$\pm$170 B.P. (and one locality), an age

coinciding with the widely known, early Holocene fluvial period. Fault features within the foothills paleosol were evaluated with techniques involving particle size distribution, pH, Ca/Fe ratios, and clay mineralogy.

Special Report 150. Mammoth Lakes, California earthquakes of May 1980. Edited by Roger W. Sherburne. 141 p., 1 plate (scale 1:62,500). $5.00. This report contains eleven contributions presenting background information, and describing post-earthquake field programs and tentative results developed from these earthquake studies. Topics covered are related to the geologic, geodetic, ad seismologic environment of the area, and the field programs conducted principally the California Division of Mines and Geology staff following the 25 May 1980 M 6 events.

Special Publication 57. Proposed earthquake safety programs and activities of the Department of Conservation fiscal years 1982 through 1986. By James F. Davis, State Geologist and staff of the California Division of Mines and Geology. 38 p. 2 figures. $2.00. This report was developed for the Seismic Safety Commission. Emphasis of the five-year schedule is on field work and regional observations that bear directly on the needs of local and state government for public safety information. The projects include: (1) identification, delineation, and evaluation of potential earthquake generating faults; (2) characterization of wave propagation and predicition of ground rupture; (3) earthquake prediction; and (4) increasing public safety by improving public awareness of earthquake hazard and risk.

Special Publication 58. Mines and mineral producers active in California in 1981. By John S. Rapp, Michael S. Silva, Michael W. Manson, Dennis L. Bane, and Edmund W. Kiessling. $2.00. This is a revised and updated version of the list of active mineral producers published in 1979 as Special Publication 53. In this new version the data are arranged into three lists. One is simply a list of the active mining companies in California; the address of the company is included in each entry. The other two are differently organized lists of about 950 active mines in California: One lists the mines by commodity, the other by county of location. Each entry includes the name of the mine, its location by latitude and longitude, and the name and address of the owner-operator. Each entry in the list of active mines by county includes the name of the commodity

Special Publication 60. Earthquake planning scenario for a magnitude 8.3 earthquake on the San Andreas fault in southern California. By James F. Davis, John H. Bennett, Glenn A. Borchardt, James E. Kahle, Salem J. Rice, and Michael P. Silva. 128 p. 16 maps. $6.00. This scenario portrays anticipated damage to the highway, airport, railway, marine, communication, water, waste disposal, electrical power, natural gas, and petroleum lifelines that service the metropolitan areas in the Los Angeles Basin and environs when they are subjected to the large (magnitude 8.3) earthquake expected to take place during the lifetime of many of the current residents of southern California. Most of the lifelines will experience significant adverse effects. Coping with each of these results, taken alone, would require a major emergency-response effort. The combined inpacts of all the lifelines being simultaneously

impaired by the scenario earthquake will greatly escalate the problem. The added strain of dealing with the expected 3000 to 14,000 dead and with 12,000 to 55,000 casualties requiring hospitalization resulting from this earthquake will put an unprecedented demand upon government institutions, utilities, businesses, individuals, and society in general. The circumstances will be catastrophic. The information presented in this report is intended to be a basis for such planning and preparedness.

Preliminary Report 24. Processed data from the Gilroy array and Coyote Creek records, Coyote Lake, California, earthquake 6 August 1979. By A.G. Brady, P.N. Moak, V. Perez (USGS), and Larry D. Porter. This report contains plots of the results of completed processing performed on the six close-in records obtained from the Coyote Lake earthquake of August 1979. The six-station Gilroy array, first established by the USGS in November 1971, is to become part of the CDMG network after the final checkout of new instrumentation is completed. Array stations 1, 2, 3, 4, and 6 were installed and operational at the time of the August 6 earthquake. The processing of the records from these five and the San Martin-Coyote Creek stations is the subject of this report.

Preliminary Report 26. Compilation of strong-motion records and preliminary data from the Imperial Valley earthquake of 15 October 1979. By R.D. McJunkin and J.T. Ragsdale. 53 p., 3 tables. $2.00. This report summarizes California Division of Mines and Geology, Strong Motion Instrumentation Program accelerograph records recovered from the magnitude 6.6 Imperial Valley earthquake of October 1979.

Preliminary Report 27. Strong-motion records from the Mammoth Lakes earthquakes of May 1980. By C.D. Turpen. 42 p. 3 tables, 4 figures. $2.00. This preliminary report summarizes California Division of Mines and Geology, Strong Motion Instrumentation Program accelerograph records recovered from the 25 through 27 May 1980 Mammoth Lakes area earthquake sequence. Records from 15 CDMG accelerograph stations that were activated by one or more of the earthquakes are discussed.

Preliminary Report 28. Strong-motion records from the Livermore earthquakes of 24 and 26 January 1980. By Richard D. McJunkin and John T. Ragsdale. 91 p., 6 tables, 2 figures. $2.50. The report summarizes California Divison of Mines and Geology, Strong Motion Instrumentation Program accelerograph records recovered from the 24 and 26 January 1980 earthquakes. All CDMG accelerograph stations that were triggered by the earthquakes are listed with their respective ground accelerations and other pertinent earthquake data arranged in order of increasing epicentral distance.

Map Sheet 30. Geology of the S.E. 1/4 Oat Mountain Quadrangle, Los Angeles, California. By Richard B. Saul. 19 p. Text & map (scale 1:12,000), 2 cross sections. $6.00. This study describes geologic hazards of the area which may affect suburban development and land-use decisions. The geology is shown at scale 1:12,000. Two cross sections through the mapped area show the faulted, folded, and tilted character of the underlying rock. The study area is in the Transverse Ranges geomorphic province.

Map Sheet 40. Recency and character of faulting offshore metropolitan San Diego, California. By M.P. Kennedy and E.E. Welday. Scale 1:50,000. $3.50. Map Sheet 40 consists of a map (scale 1:50,000) of the immediate offshore shelf and San Diego Bay area showing locations of faults and subbottom reflection profiles, six subbottom reflection profiles delineating subbottom fault features, and a brief text printed on the map sheet.

Map Sheet 41. Recency and character of faulting offshore from metropolitan San Diego, California, area 2 of 3, Cardif-by-the-Sea to Point La Jolla. By M.P. Kennedy, H.G. Greene, S.H. Clarke, and K.A. Bailey. Map scale 1:50,000. $3.50. Map sheet 41 covers the area adjacent to the coast from Cardiff-by-the-Sea to Point La Jolla. Printed on the sheet are the map (scale 1:50,000) showing locations of faults and subbottom reflection profiles, ten representative subbottom reflection profiles, and a brief text. This map sheet covers area 2 of 3 areas offshore from metropolitan San Diego.

Map Sheet 42. Recency and character of faulting offshore from metropolitan San Diego, California. By M.P. Kennedy, S.H. Clarke, H.G. Greene, and M.R. Legg. Map scale 1:50,000. $3.50. Map sheet 42 covers the area from Point La Jolla southward to the international border. The map shows the bathymetry of the offshore area, location of subbottom reflection profiles, and the faults of the Coronado Bank fault zone in the southern California borderland.

Geologic Data Map #3. Gravity map of California and its continental margin. By H.W. Oliver, R.H. Chapman, S. Biehler, S.L. Robbins, W.F. Hanna, A. Griscom, L.A. Beyer, and E.A. Silver. Map scale 1:750,000. Folded: $5.00; rolled: $6.50.

Geologic Data Map #4. 1980 geothermal resources of California. By C.T. Higgins. Map scale 1:750,000. Map produced for the Division of Geothermal Energy, U.S. Department of Energy. Free. The map shows the location and temperature of more than 600 geothermal wells and springs in California. The sheet is 4 1/2 by 5 feet, printed on a topographic base with various features shown in five colors. A table printed on the map sheets lists the location and name of the spring or well, water temperature, amount of flow, salt content, and depth of water. Emphasis on the study was on identification of low- and moderate-temperature subsurface water.

New regional geologic map series. Sacramento sheet. By D.L. Wagner, C.W. Jennings, T.L. Bedrossian, E.J. Bortugno, G.J. Saucedo. Includes geologic map, explanation, location of rock samples dated by radiometric methods, and index to geologic maps used in compilation. Scale 1:250,000. $12.00.

CDMG Centennial Postcards. 5 by 7 inches. 20¢ each or 6 for $1.00.

The California Division of Mines and Geology published the following two postcards as part of its centennial celebration.

Simplified geologic map of California: Eleven colors depict some of the major rock types. The card is a reduced version (with modified legend) of the Geologic Map of California. Map scale 1:2,500,000.

Simplified fault map of California: This five-color card shows faults that have ruptured in the last 200 years (historic faults) in red, and faults that have ruptured in the last 2 million years (Quaternary faults) in blue. Also shown are the locations of thirty historic earthquakes where ground displacement took place, ten locations where fault creep has been detected, and eight locations where triggered creep has occurred.

Seventy-second Report of the State Geologist (1978-79). No charge.

Seventy-third Report of the State Geologist (1979-80). No charge.

b. Publications reprinted/revised.

Bulletin 193. Gold districts of California. By William B. Clark. $6.50.

Special Publication 42 (revised 1980). By Earl W. Hart. Fault-rupture hazard zones in California. $1.00.

Special Publication 51. State policy for surface mining and reclamation practice (First revision, June 1979). Prepared by the California State Mining and Geology Board. No charge.

Map Sheet 39. Earthquake epicenter map of California, 1900 through 1974. By Charles R. Real, Tousson R. Toppozada, and David L. Parke. $2.00.

The following sheets of the Geologic Map of California, scale 1:250,000 were reprinted:

San Francisco
Death Valley
Colored folded. $2.50.
Colored flat. $2.50.
Uncolored flat. $1.50.

c. CALIFORNIA GEOLOGY

Articles published in the monthly earth science magazine were:

Fault Evaluation and Zoning Program
A tectoanic mystery...basement rock clasts in the Temblor Range, San Luis Obispo and Kern Counties, California
Index to graduate theses and dissertations on California Geology, 1977 and 1978.
Geophysical Investigation Program
A Geophysical approach to locating Tertiary gold channels, Port Wine, Sierra County, California
Geology of the Terry borate deposit, Amargosa Valley, Inyo County, California
An overview...Minerals Program, Division of Mines and Geology
Mammoth Lakes earthquakes, May 25-27, 1980, Mono County, California
Slope failures in Orange County due to 1978 rains.

Summary of activities--State Mining and Geology Board report
Strong Motion Instrumentation Program
1979 mining review
Earthquake damage to mobile homes in California
Publications Program
Diving for gold in California
Geothermal program...the search for hot water in California
A summary...tectonic history of the area north of San Francisco Bay
Seismology Program
Manmade environmental changes...acidic surface deposits in California and Nevada
An evaluation of the seismic window theory for earthquake prediction
Mount St. Helens, Vancouver, Washington
New insight on 1906 San Francisco earthquake
The environmental review process for new mining projects in California
An overview of CDMG offices and staff
Uranium mineralization of the Sonora Pass region, Tuolumne County, California
Gorda Basin earthquake, northwestern California
Tsunamis
Historical use of moderate-temperature geothermal resource, Calistoga, Napa County, California
Our dependence on mineral resources
Platinum-group minerals in alluvial deposits, northern and central California
Source of Mother Lode gold
California earthquakes--end to seismic quiescence

Subsidence of organic soils, Sacramento-San Joaquin delta
Newport-Inglewood zone of deformation
History of placer mining for gold in California Sierra Nevada Province
Earthquake prediction: The scientist's responsibilities and public response
Volcanic history and "active" volcanism in California
Gold mining activity in California
Careers in geology
CRC geotech program
California's diatomite industry
History of mining and milling methods in California
Expansive soils-volume change and expansion pressure of smectites
Volcanic hazards workshop, December 3 and 4, 1981, Sacramento, California
Calistoga geothermal resource area
1980 mining review
Seasat views of California
Geothermal resources of California
Geologic history of the Sierran gold belt
New regional geologic map series
Recent sedimentation along the Big River Estuary
Gravity map of California
Coastal sand dune complexes, Pismo Beach and Monterey Bay
Preliminary results from the strong-motion accelerograph array in Taiwan

Seismic refractions study of the El Modeno fault, Orange County
Tertiary gold-bearing mercury deposits of the Coast Ranges of California

d. Revised CDMG Notes

CDMG Note 1. Locating a placer mining claim
CDMG Note 2. Locating a lode mining claim
CDMG Note 3. Faults and earthquakes
CDMG Note 5. Serpentine--California state rock
CDMG Note 7. Marketing of gold
CDMG Note 8. Lands open to prospecting and location in California
CDMG Note 9. CALIFORNIA GEOLOGY magazine subscription form
CDMG Note 11. Earthquake articles in MINERAL INFORMATION SERVICE, 1960-1970 and CALIFORNIA GEOLOGY, 1971-1981
CDMG Note 14. State geological surveys of the United States
CDMG Note 21. Life through geologic time
CDMG Note 22. Gold: State mineral
CDMG Note 24. Mines--lost and abandoned
CDMG Note 25. Fossils and paleontology
CDMG Mote 27. How organisms become fossils
CDMG Note 29. @@5AMining claims are not for cabin sites@@5A
CDMG Note 31. Searching for records of mines and miners
CDMG Note 32. Assessment work on mining claims
CDMG Note 34. Meteorites
CDMG Note 36. How to order CDMG publications
CDMG Note 38. Sabre-tooth cat: Official state fossil
CDMG Note 50. Surface Mining and Reclamation Act of 1975

e. Open-File Reports

Reports of Division investigations are released on open-file to make the data available as soon as possible after the studies are completed. This enables interested professional geologists and other users to obtain the data prior to formal publication. The following reports were released on open-file during fiscal years 1980-81 and 1981-82:

Los Angeles District

OFR 77-7 LA. Geologic maps and cross sections of the Calabasas-Agoura-eastern Thousand Oaks area, Los Angeles and Ventura Counties, California. Plate 1. Geologic framework of Calabasas-Agoura-Thousand Oaks-Simi Valley region, Los Angeles and Ventura counties (one sheet; scale 1:48,000). Plate 2a-d. Geologic map of NW 1/4 and S 1/2 of Thousand Oaks quadrangle and S 1/2 of Calabasas guadrangle, Los Angeles and Ventura counties (3 map sheets plus explanation sheet; scale 1:9.600) (The S 1/2 of the S 1/2 of the Thousand Oaks quadrangle is by B.A. Blackerby). Plate 3a-c. Geologic cross sections through the Calabasas-Agoura-eastern Thousand Oaks area (3 sheets; scale 1:9,600). Plate 4. Generalized geologic terranes ("planning") map of NW 1/4 and S 1/2 Thousand Oaks quadrangle and S 1/2

of Calabasas quadrangle, Los Angeles and Ventura counties (one sheet; scale 1:24,000). The area studied extends north and south along U.S. Highway 101 from Calabasas on the east to Thousand Oaks on the west, encompassing about 85 square miles mapped at a scale of 1:9,600. Additional communities include Westlake Village and parts of Woodland Hills and Canoga Park of the City of Los Angeles. The south part of the area consists of part of the Santa Monica Mountains and the north part includes the Simi Hills. Additional topographic features include Los Virgenes, Liberty, Cheeseboro, Palo Comado, Lindero, Skeleton and Triunfo Canyons, Russell Valley, Ladyface and Simi Peak. The area is one of the most rapidly growing in population in southern California. The geology of the area consists principally of complexly folded shale, siltstone and sandstone of the Topanga and Modelo formations of middle and late Miocene age, along with middle Miocene volcanic rocks and rocks of several older formations. Well-identified, probable and possible ancient bedrock landslides are common in terranes especially that consist of shale and siltstone of the Modelo and Topanga formations.

OFR 79-8 LA. Environmental geology of Orange County, California. By Paul K. Morton, Russell V. Miller, and James R. Evans. The purpose of this report is to provide an overview of the geologic conditions affecting the environment, including those that affect the safety and well-being of the present and future pupulation of Orange County. The report contains a series of maps showing the geology, landslides, location of mineral deposits, fault activity, relative seismic shaking and liquefaction potential, earthquake epicenters, analysis of slope stability, expansive soils, peat distribution, subsidence and uplift, and tsunamis risk. The text is a compendium describing the 31 principal rock units and the mines and mineral deposits in the county. Also included are sections on seismicity, slope stability, erosion, subsidence and uplift, expansibility, and flooding, and a comprehensive reference list. 5 plates (scale 1:48,000).

OFR 79-14 LA. Slope stability study of the Baldwin Hills, Los Angeles County, California. By CDMG staff (E.Y. Hsu, R.B. Saul, S.S. Tan, J.A. Treiman, and F.H. Weber, Jr.). The report comprises 162 pages of text and 5 plates. The text contains introductory sections on the topography and geology of the hills and evolution of local grading codes as related to grading practices during tract development. Slope failures are described in detail in tables and suggested measures to stabilize slopes damaged by landsliding and erosion are given. The final chapter consists of a general description of measures that can be taken to stabilize slopes in the hills. Two of the plates depict slope failures at large scale and one shows individual properties that have been damaged by slope failure in 1969, 1978, and 1980. A fourth plate consists of a geologic map that was compiled mainly from previous work. A fifth plate shows localities for rock and soil samples from which engineering data are tabulated.

OFR 79-16 LA. Earthquake hazards associated with faults in the greater Los Angeles metropolitan area, Los Angeles County, California, including faults in the Santa Monica-Raymond, Verdugo-Eagle Rock, and Benedict Canyon fault zones. By Robert L. Hill, Edward C. Sprotte, Rodger H.

Chapman, Gordon W. Chase, John H. Bennett, Charles R. Real, Richard C. Slade, Glenn Borchardt, and F. Harold Weber, Jr. This is the first of two reports prepared as part of a study of faulting in the central Los Angeles region that was initiated in 1974 by Robert L. Hill. The report consists of five chapters: A. Summary for final technical report covering period February 9, 1978-July 8, 1979 (By R.L. Hill); B. Location and activity of the Santa Monica fault, Beverly Hills-Hollywood area, California (by R.L. Hill, E.C. Sprotte, J.H. Bennett, C.R. Real, and R.C. Slade); C. Soil development associated with the Raymond fault, San Marino, California - a preliminary report (by Glenn Borchardt and R.L. Hill); D. Geology and surface features related to character and recency of movement along faults, north-central Los Angeles area, Los Angeles County, California - a preliminary report (by F. Harold Weber, Jr.) (includes preliminary geologic map, plate 1); and E. Geophysical investigation of the Santa Monica-Raymond fault zone, Los Angeles County, California)by R.H. Chapman and G.W. Chase) (includes gravity map of the area, Plate 1G).

OFR 80-1 LA. Earthquake Hazards Associated with Verdugo-Eagle Rock and Benedict Canyon Faults, Los Angeles County, California (Semi-annual report for USGS Grant 14-08-001-18245). By Rodger H. Chapman and Gordon W. Chase. This report consists principally of the second and final part of a two-phase study of the geophysical aspects of the faults of the north-central Los Angeles area; the first part is contained in Chapter E of OFR 79-16 LA. In addition, a brief progress report on surface and subsurface aspects of the final phase of the study is presented by F. Harold Weber, Jr. and R. B. Saul.

OFR 80-2 LA. Geologic Map of the San Andreas Fault Zone, Juniper Hills and vicinity, Los Angeles County, California. By Allan G. Barrows. This report consists of a geologic map, explanation, and cross sections of the Juniper Hills area. The map, scale 1:9,600, will be accompanied by a text in a Special Report to be published at a later date. The Juniper Hills area lies on the north side of the San Gabriel Mountains, southeast of Palmdale near Littlerock and Pearblossom. The geology of this area is very significant because the geographically attractive area is undergoing development and it is bisected by the San Andreas fault zone. During the great earthquake of 1857, the ground surface along the San Andreas fault was ruptured through the Juniper Hills area. Other faults in the area acting in concert with the San Andreas, also may have locally disturbed the ground surface.

OFR 80-3 LA. Landsliding and flooding in southern California during the winter of 1979-1980. By F. Harold Weber, Jr. The report comprises 69 pages of text, figures and photographs in which areas damaged within the six counties most affected by the rains are described. In addition, conclusions are reached relative to the geologic and social-government aspects of damage. Also given are recommendations, as developed by the Department of Conservation, for state and local legislation to ameliorate further the hazards of landsliding in California.

OFR 80-10 LA. Earthquake hazards associated with the Verdugo-Eagle Rock and Benedict Canyon fault zones, Los Angeles County, California. By F.H. Weber, Jr., J.H. Bennett, R.H. Chapman, G.W. Chase, and R.B. Saul. The report contains the results of a study of the Verdugo, Eagle Rock, and San Rafael fault zones which make up a system of faults that extends southeast along the northeast side of the san Fernando Valley from San Fernando to Pasadena. 2 plates.

OFR 80-13 LA. Fault activity of the Three Points and Pine Canyon Segments, San Andreas fault zone, Los Angeles County, California. By James E. Kahle and Allan G. Barrows. This report consists of annotated fault maps of each segment (scale 1:12,000) and accompanying text on the faults and fault activity of a 20 km stretch of the San Andreas fault zone. The area mapped lies 15 km east-southeast of Gorman and 35 km west-northwest of Palmdale.

OFR 80-16 LA. Geology for planning: Imperial Beach 7 1/2' quadrangle, San Diego County, California. By Marjorie Bushnell, Lalliana Mualchin, and Richard Kilbourne. The categories of geologic hazards and resources compiled and documented for the studies area include: earthquake hazards of ground rupture, shaking, and liquefaction; slope stability problems of existing landslides, steep slopes in poorly consolidated sediments, and eroding shorelines; flood hazards of the 100-year flood, 100- and 500-year tsunami and dam failure; geologic resources of sand and gravel, bentonitic clay, salt, ground water, geothermal heat, and unique geologic features. The data will be useful to planners, developers, and reviewers involved in land use planning by providing a summary of the teologic data base and the identification of the geologic constraints and opportunities that are present in the region. 3 plates (scale 1:24,000).

OFR 80-18 LA. Mineral land classification of Pfizer, Inc. limestone deposits in Lucerne Valley area, San Bernardino County, California. By R.M. Miller and P.K. Morton. The report describes the properties comprising the Pfizer, Inc. limestone operation in Lucerne Valley, California. 2 plates (scale 1:24,000).

OFR 80-19 LA. Classification and mapping of quaternary sedimentary deposits for purposes of seismic zonation, South Coastal Los Angeles Basin, Orange County, California. Second year interim report. By E.C. Sprotte, D.R. Fuller, R.B. Greenwood, H.A. Mumm, C.R. Real, and R.W. Sherburne. This report describes interpreted highest historic ground water levels, surficial soil characteristics, thicknesses of Quaternary and Holocene sedimentary deposits and the Talbert-Bolsa aquifer system in Orange County. Additional description and analysis of a down hole seismic velocity survey conducted in the study area and documentation of the electronic data processing program for this continuing project are included in this interim report. 19 plates.

OFR 81-2 LA. Engineering geology of the north half of the El Toro quadrangle, Orange County, California. By Siang S. Tan, Russell V. Miller, and Donald L. Fife. This engineering geologic study of an area of about 30 square miles was done under a cooperative agreement between the California Division of Mines and Geology and the County of Orange. It was undertaken to provide a basic geologic reference for planning

urban developmnent for use by governmental agencies, geologists and engineers, as welll as the general public. Particular emphasis was given to environmental, economic, and engineering geologic features within the study area. 1 plate (scale 1:12,000).

San Francisco District

OFR 80-5 SF. Geology for planning: Point Sal and Guadalupe 7 1/2' quadrangles, Santa Barbara and San Luis Obispo Counties, California. By Richard Kilbourne and Lalliana Mualchin. Several categories of geologic haza rds and resources are compiled and documented for area of study, including historic and future earthquake hazards, slope instability, liquefaction potential, 100-year and 500-year distant source tsunami runup, 100-year and dam-failure flood plains, unique geologic features, and ground water, diatomite, and fossil fuel resources. The report provides a summary of the geologic data base and the identification of the geologic constraints and opportunities present in the region. The information will be useful to planners, developers, and reviewers involved in land-use planning 4 plates (scale 1:24,000).

OFR 80-6 SF. Geology for planning: Cayucos and Cypress Mountain 7 1/2' quadrangles, San Luis Obispo County, California. By Richard Kilbourne and Lalliana Mualchin. The categories of geologic hazards and resources compiled and documented for the study area include historic and future earthquake hazards, landslides, liquefaction potential, 100-year and dam-failure flood plains, 100-year and 500-year distant source tsunami runup, valuable mineral deposits, and unique geologic features.

The data will be useful to planners, developers, and reviewers involved in land-use planning by providing a summary of the geologic data base and the identification of geologic constraints and opportunities that are present in the region.

OFR 80-7 SF. Geology for planning: Marina and Salinas 7 1/2' quadrangles, Monterey County, California. By Richard T. Kilbourne and Lalliana Mualchin. Geologic hazards and resources are compiled and documented for the study area. These include historic and future earthquake hazards, slope failure and liquefaction potential, 100-year and dam-failure flood plains, 100-year and 500-year distant source tsunami runup, beach erosion, and sand and gravel, fossil fuel, and water resources. The report is useful to planners, developers, and reviewers involved in land-use planning by providing a summary of the geologic data base and the identification of the geologic constraints and opportunities that are present in the region.

OFR 80-9 SF. Geology for planning: Eureka and Fields Landing 7 1/2' quadrangles, Humboldt County, California. By Richard T. Kilbourne, Lalliana Mualchin, and George Saucedo. Several categories of geologic data are compiled and documented for the area of study, including historic earthquake-induced ground failure, regional seismic hazards, potentially active faults, slope instability, liquefaction potential, 100-year and 500-year distant source tsunami runup, 100-year flood plains, and ground water, unique geologic features and fossil fuel

resources. The report will be useful to planners, developers, and reviewers involved in land-use planning by providing a summary of the geologic data base and the identification of geologic constraints and opportunities that are present in the region. Needs and recommendations for future studies are documented. 4 plates (scale 1:24,000).

OFR 80-11 SF. Environmental geologic analysis of the Tar Creek south study area, Santa Clara County, California. By Charles F. Armstrong. The study was undertaken to delineate geologic hazards to development in this study area. This report is intended for use by planners, building inspectors, geologists, engineers, and homeowners, as an input for land-use planning as well as for preliminary site selection for buildings, roads, and utilities. 2 plates (scale 1:12,000).

OFR 81-1SF. Geology for planning: Crescent City and Sister Rocks 7 1/2' quadrangles, Del Norte County, California. By Richard T. Kilbourne and Lalliana Mualchin. Geologic hazards and resources are compiled and documented for the study area. These include historic and future earthquake hazards, slope instability, liquefaction potential, 100-year and 500-year distant source tsunami runup, 100-year flood plain, ground water, chromium, and unique geologic feature resources. The information is useful to planners, developers, and reviewers involved in land-use planning by providing a summary of the geologic data base and the identification of which geologic constraints and opportunities are present in the region. Needs and recommendations for future studies are documented. 4 plates (scale 1:24,000).

OFR 81-3 SF. Summary report--fault evaluation program, 1979-1980 area (southern San Francisco Bay region. By E.W. Hart, W.A. Bryant, W.A. Bryant, T.C. Smith, T.L. Bedrossian, and D.P. Smith. This report summarizes the results of the fourth and fifth years of the Fault Evaluation Program. During 1979-1980, numerous potentially active faults in the southern San Francisco Bay Region were stidied to evaluate the hazard of surface fault rupture. Those faults meeting the criteria of "sufficiently active and well defined" were recommended for zoning under the Alquist-Priolo Special Studies Zones Act. The proposed new and revised zones are on the Hayward, Calaveras, San Andreas, Las Positas, Greenville, Seal Cove, San Gregorio, and other faults. Forty new and revised zone maps were issued for preliminary review on July 1, 1981, as a result of the 1979-1980 work. The designated faults are identified on a map, scale 1:250,000. Data on recency of faulting and recommendations for zoning are summarized in table form.

OFR 81-5 SF. Preliminary map of October 1979 fault rupture, Imperial and Brawley faults, Imperial County, California. By E.W. Hart, 1981. This 5-part map identifies the locations of fault rupture that occurred during and following the October 15, 1979 Imperial Valley earthquake. In addition, descriptions and dates of observations of fault-rupture features are provided as annotations. The map (Brawley, Alamorio, El Centro, Holtville West, and Calexico quadrangles) is based on field observations made during the period of October 16 to 24, 1979, at which time it was not possible to "walk out" all ground ruptures. Additional ground rupture also may have occurred since that time. A more complete report and map is expected to be issued by the U.S. Geological Survey in

the future, based on the results of many investigators over a longer period of time. Map in 5 parts (scale 1:24,000).

OFR 81-6 SF. Evidence of Holocene movement of the San Andreas fault zone, northern San Mateo County, California. By Theodore C. Smith. The annotated map identifies the principal breaks of the San Andreas fault, along which repeated movement probably has occurred in Holocene time. The data portrayed are primarily based on the interpretation of aerial photographs taken prior to development of the area, supplemented by available information on historic rupture. This map was originally produced as part of the Divison's Fault Evaluation and Zoning Program and is the primary source used for the proposed revised Alquist-Priolo Special Studies Zones maps of the San Francisco South and Montara Mountain quadrangles. 1 plate (scale 1:24,000).

OFR 81-7 SF. Sargent, San Andreas, and Calaveras fault zones: Evidence for recency in the Watsonville east, Chittenden, and San Felipe quadrangles, California. By William A. Bryant, Drew P. Smith, and Earl W. Hart. 3 maps. Scale 1:24,000. Surface evidence for recently active faults of the Sargent, San Andreas, and Calaveras fault zones is summarized on these maps. Information on the Sargent fault is new and indicates that the southeast segment of that fault has been active during Holocene time. Data on the San Andreas and Calaveras faults supplement existing information on these well-known, active faults.

OFR 81-8 SF. Recently active strands of the Greenville fault, Alameda, Contra Costa, and Santa Clara counties, California. By Earl W. Hart. Over-size map. Scale 1:24,000. This map identifies the recently active strands of the Greenville fault and summarizes evidence for recent faulting. The fault was not demonstrated to be active prior to the minor surface faulting associated with the January 25 and 27, 1980 earthquakes. Mapping showed that ground rupture was confined to a 4.5-mile segment of the fault in the vicinity of Livermore Valley. Since then, additional mapping indicates that the Greenville fault may be active over a length of 32 miles.

OFR 82-9 SF. Evidence for recent faulting, Calaveras and Pleasanton faults, Diablo and Dublin quadrangles, California. By Earl W. Hart. 2 maps. Scale 1:24,000. These annotated maps identify the recently active traces of the Calaveras fault, based largely on the interpretation of aerial photographs and verified by trench excavations of others. Although recent faulting is somewhat complex and commonly obscured by landslides, the fault appears to be active as far north as San Ramon. The Pleasanton fault, inferred by others to be historically active, cannot be mapped as a throughgoing fault. Only in the vicinity of Camp Parks is it possibly active, and even there the recent features may be artificial or due to other causes.

OFR 81-12 SF. Geology and slope stability in the west Sebastopol study area, Sonoma County, California. By Trinda L. Bedrossian. 42 p. 2 maps. Scale 1:24,000. This report was prepared in cooperation with the Sonoma County Planning Department. Aerial photo interpretation and field investigation were conducted in a 32-square mile area approximately 60 miles north of San Francisco and 15 miles west of Santa Rosa. Results of

the study may be used for land-use planning and as general background information for the selection of areas most suitable for buildings, roads, and utililties. Specifically, maps identify geologic hazards and potential geologic problems that should be studied in detail prior to development. An interpretation of relative slope stability is presented, and engineering properties of most of the rock units are summarized.

OFR 82-14 SF. Geology of the Rodgers Peak quadrangle, Humboldt County, California. By Patricia Cashman, Susan M. Cashman, and Harvey M. Kelsey. Scale 1:24,000. Except for the Redwood Creek drainage, which is covered by a U.S. Geological Survey Water Resources Division map by Harden and others (Open-File Report 81-496) released in 1981, the area was only covered by unpublished and small scale reconnaissance geological maps. This map shows the distribution of rock types, location of faults, and geologic structure. The area is largely underlain by Franciscan assemblage rocks, which have been subdivided into five principal units. Parts of three major faults cross the quadrangle--the Bald Mountain, Big Lagoon and Grogan faults.

OFR 82-15 SF. Geology of the Coyote Peak quadrangle, Humboldt County, California. By Susan M. Cashman, Patricia H. Cashman, K.R. Aalto, and Harvey M. Kelsey. Scale 1:62,500. Except for the Redwood Creek drainage, which was mapped by Harden and others (USGS Open-File Report 81-496, 1981) of the U.S Geological Survey Water Resources Division, the only published geologic map of the area was a 1:500,000 scale reconnaissance map. The new map shows the distribution of rock types, faults, geologic structure and an unusual feature called the Coyote Peak diatreme--a breccia-filled volcanic pipe.

Sacramento District

OFR 81-11 SAC. Preparation of isoseismal maps and summaries of reported effects for pre-1900 California earthquakes. By T.R. Toppozada, C.R. Real, and D.L. Parke. This is the third annual and final report of a three-year project to clarify the earthquake history of California for the period before 1900. This report contains an update of all the information contained in the previous two annual reports. The information for each of 137 pre-1900 earthquakes includes: (1) estimates of location, magnitude, and the size of areas shaken at various intensities; (2) an isoseismal map, when sufficient data (100 earthquakes) were available; (3) a brief description; (4) a bibliography of the data sources; and (5) a summary of reported effects and assigned intensities. The main item that appears for the first time in this report is a set of isoseismal maps showing the distribution of intensity reports which control the estimates of location and magnitude.

OFR 80-12 SAC. Preliminary map of surface rupture associated with the Mammoth Lakes, California earthquakes, May 25 and 27, 1980. By William A. Bryant, Gary C. Taylor, Earl W. Hart, James E. Kahle, Trinda L. Bedrossian, and Richard D. McJunkin. This report is the preliminary result of observations and field mapping by Division of Mines and Geology personnel of surface fault rupture associated with the Mammoth Lakes

earthquake swarm. The distribution of surface rupture observed May 26 through May 31 is plotted on the 15-minute Mount Morrison quadrangle (scale 1:62,500). A tabulation of observations made by CDMG personnel is keyed to locations on the map. Fault locations were compiled from Rinehart and Ross (1964), Bailey and Koeppen (1977), and from aerial photo interpretation by W. Bryant, E. Hart, and G. Taylor which is also plotted on the map.

OFR 80-15 SAC. Preparation of isoseismal maps and summaries of reported effects for pre-1900 California earthquakes. By T.R. Toppozada, C.R. Real, S.P. Bezore, and D.L. Parke. This is the second annual report of the three-year project to clarify the earthquake history of California for the period before 1900. This report superseces OFR 79-6SAC, the first annual report, in that (a) additional earthquakes were studied, (b) earthquakes studied during the first year were re-evaluated in the light of newly obtained information, (c) the bibliographies of data sources were updated, (d) for every locality reporting an earthquake a summary of the reported effects is given with the assigned intensity, (e) brief descriptions of the earthquakes are provided, and (f) a measure of epicentral uncertainty is given for each earthquake.

OFR 82-5 SAC. Drill hole logs and logging procedures for Mammoth Lakes/Long Valley DOE micro-earthquake project. By Richard T. Boylan. 40 p. 4 figures. This drilling, Department of Energy-funded project grew out of a need to investigate the Long Valley known Geothermal Resource Area with the intention of improving the data quality, precision, and effectiveness of micro-earthquake monitoring as a tool for geothermal explorations. Five 200-foot shot holes were drilled, logged, and loaded with explosives. Explosion-generated seismic waves were recorded using analog and digital seismic event recorders. The report does not contain an evaluation of seismic data. It does contain, however, detailed lithologic logs, interpretation of logs, and bottom-hole water temperatures.

2. Library

The Division's library, located in the San Francisco District Office, is primarily a research and source facility for the Division's professional staff, but it is also open to the public for reference reading and research use. The books, periodicals, maps and government documents in the collection represent an up-to-date, comprehensive selection of materials of use to Division scientists and investigators.

3. Mineral Exhibit

The Division's Mineral Exhibit, located on the second floor of the Ferry Building in San Francisco, is open to the general public on weekdays, Monday through Friday, from 8:00 a.m. to 5:00 p.m. On display or available for examination are representative specimens of the rocks and minerals of the state. The exhibit continues to attract visitors from all over the world.

Division activities are administered on a regional basis by the three District Geologists (see Figure 10 for district boundaries) and on a functional basis by the managers of statewide programs. The District Geologists provide administrative and resource support for program activities conducted within their respective districts.

I. Districts

As shown on the Division organization chart (Figure 11), Division activities are administered on a regional basis by the three District Geologists (see Figure 8 for district boundaries) and on a functional basis by the managers of statewide programs. The District Geologists provide administrative and resource support for program activities conducted within their respective districts.

1. Los Angeles

The Los Angeles District Office serves all of southern California and comprises 11 counties bounded on the north by, and including, the counties of San Luis Obispo, Kern, and Inyo. The District Office is located in the Junipero Serra Building at 107 South Broadway in the Los Angeles Civic Center.

The bulk of the project work of the District is concerned with geologic hazards and environmental geology as it relates to proper land use. Much of this work involves cooperative investigations with other governmental agencies, chiefly with the U.S. Geological Survey, but also with local counties. Some are special State studies. In recent years, these investigations have continued to concentrate heavily upon earthquake hazards, including studies of active and potentially active faults, but in addition considerably more emphasis has been placed on slope stability problems.

The District staff includes 20 geologists, 1 geologic aid, 2 drafting technicians, 4 secretaries, and 2 temporary student assistants. Small field offices are maintained near projects: currently field offices are located in San Diego, Santa Ana, and on the UCLA campus. The Los Angeles District maintains a public information center as well as a small technical library.

2. Sacramento

The Sacramento District Office, located at 2815 "O" Street in Sacramento, provides geologic services to 30 counties in central inland and northeastern California. In addition, this District office provides geophysical and seismological services to the entire State.

District efforts have focused on studies of crustal deformation and seismicity of California. Geological work has emphasized mineral resources and the evaluation of environmental considerations in land development.

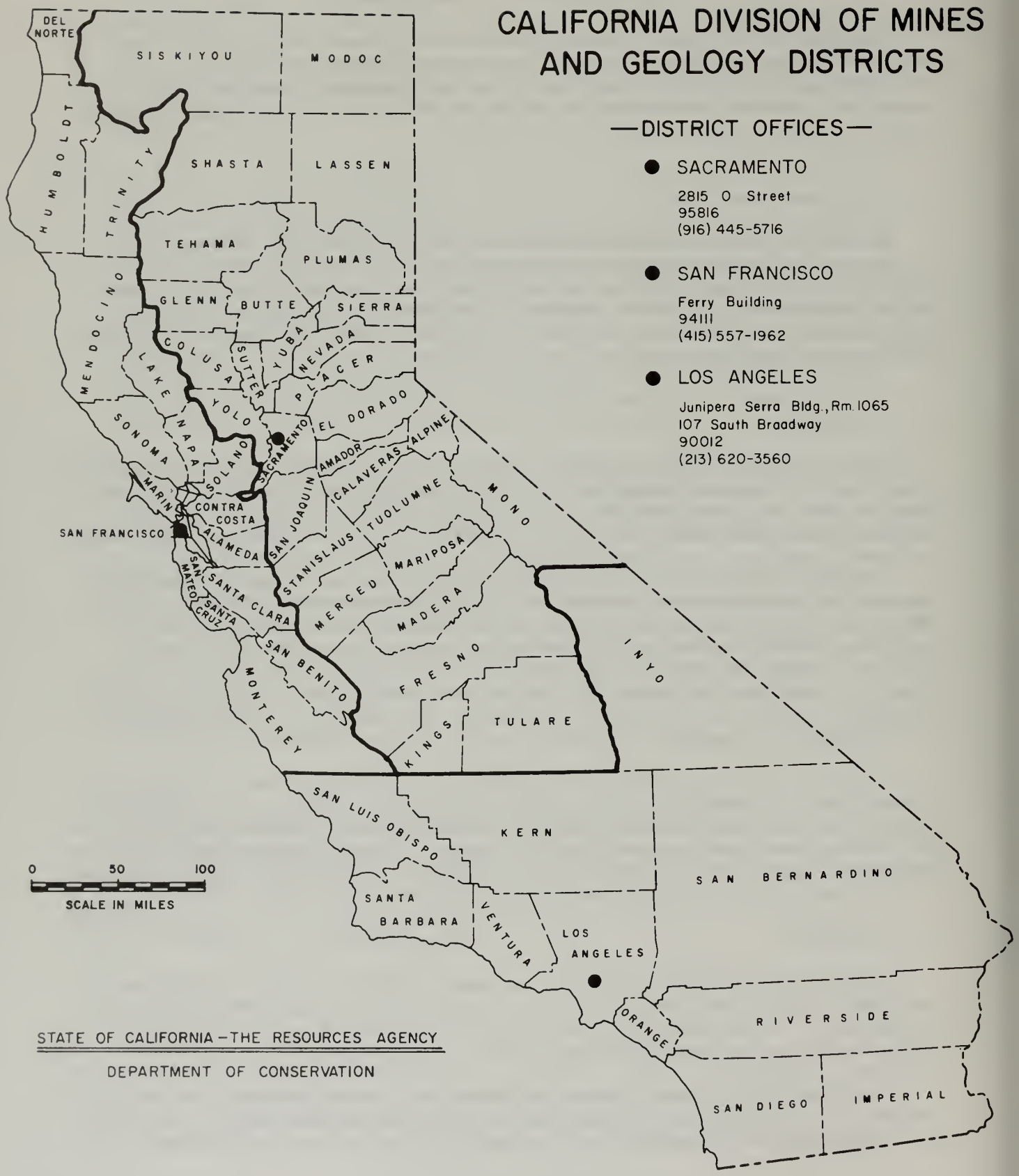

Figure 10. California Division of Mines and Geology Districts.

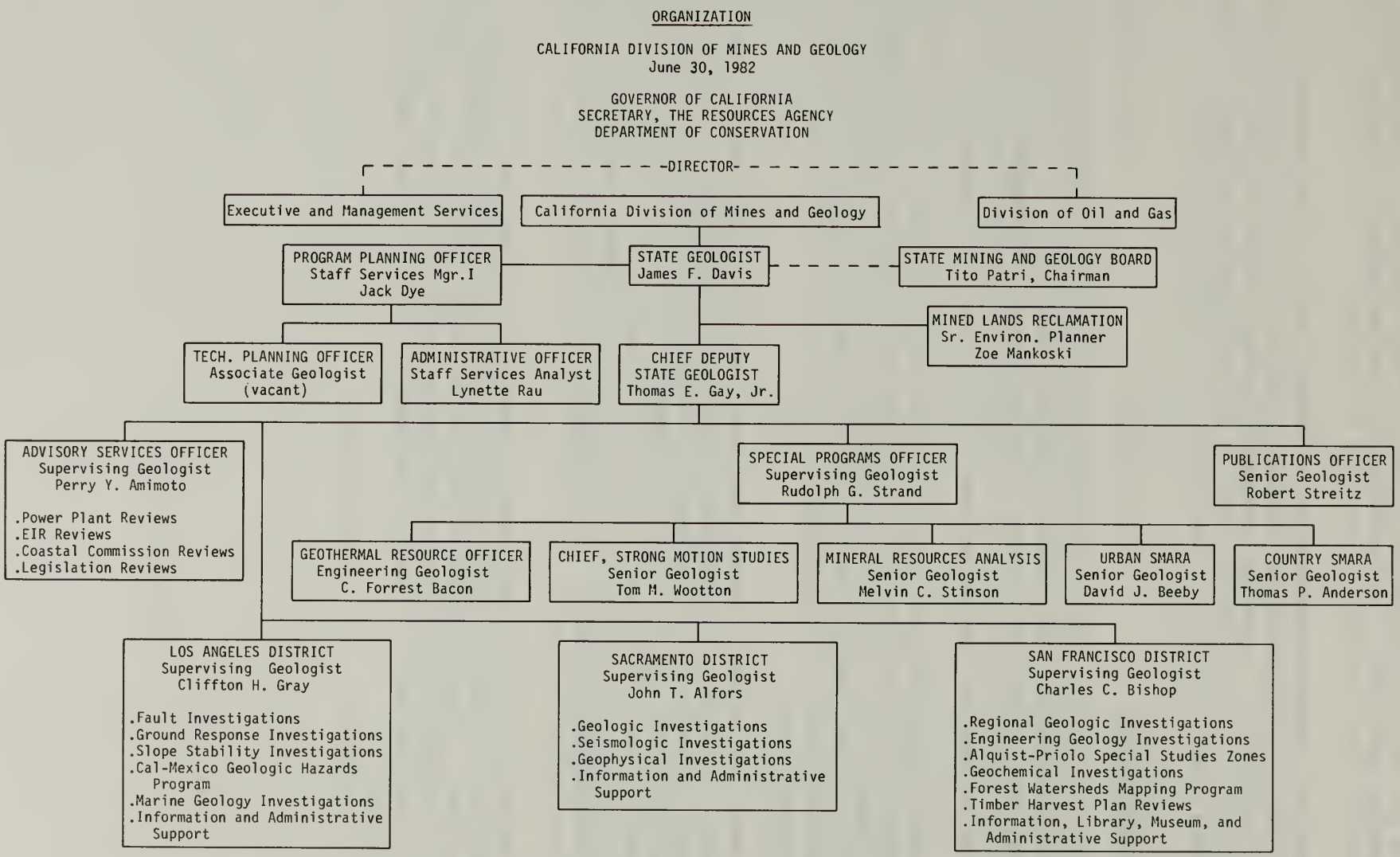

Figure 11. Organization chart for the California Division of Mines and Geology, June 30, 1982.

The staff in the Sacramento District Office consists of 2 geologists, 1 engineering geologists, 3 geophysicists, 5 seismologists, 3 geologic aids, 3 secretaries, and 1 geological drafting technician.

The staff headquartered at the 610 Bercut Drive office includes 11 geologists, 1 engineering geologist, 1 geologic aid, 1 environmental planner, 1 soil scientist, 1 botanist, 1 regional administrative officer, and 2 secretaries. In addition the District had the services of several student assistants and volunteers during fiscal years 1980-81 and 1981-82.

3. San Francisco

The San Francisco District Office, which has been housed in the historic Ferry Building since 1899, covers a working territory of 17 counties in northern and central California. This includes approximately two-thirds of the California seacoast, most of the central and northern Coast Ranges, and much of the very active San Andreas fault and related faults.

Several Division-wide facilities exist in this District office. They are the geochemical laboratory, which provides analytical and testing support to the Division staff; the map room, in which are compiled and prepared various maps such as the Geologic Map of California series; the Division's large and complete technical reference library; and one of the largest mineral exhibits on the west coast.

Investigations and studies conducted from this office include cooperative geologic investigations with Santa Clara and Sonoma counties, fault evaluation studies under the Alquist-Priolo Special Studies Zone Program, classification of lands for mineral potential under the Surface Mining and Reclamation Act (SMARA), compilation of the new series of 1:250,000 geologic maps of California, and the preparation of stratigraphic sections of many locations in California for the Correlation of Stratigraphic Units of North America (COSUNA) project.

The District staff consists of 16 geologists, 1 geochemist, 1 geochemist-soil mineralogist (working on half-time basis), 2 laboratory technicians, 2 geologic aids, 3 geologic drafting technicians, 1 librarian, 4 secretaries and clerks (plus one Office Assistant II - Typing on temporary staff), and one janitor. Use is also made of volunteers and student assistants.

HEADQUARTERS OFFICE
1416 9th Street, Room 1341
Sacramento 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Amimoto, Perry Y. (Supervising Geologist)	Advisory Services Officer	Administration
Anderson, Mildred E. (Executive Secretary I)	Executive Secretary	Headquarters Support
Davis, James F. (State Geologist)	State Geologist	Administration
Espinoza, Melissa (Stenographer)	Advisory Services Clerk	Headquarters Support
Gay, Thomas E., Jr. (Chief Deputy St. Geologist)	Chief Deputy State Geologist	Administration
Harthrong, Deborah (Student Assistant)	Editorial Aid	Publications Program
Johnson, Carole R. (Senior Steonographer)	Secretary	Headquarters Support
Johnson, Marti (Office Assistant II -Typing)	Receptionist	Headquarters Support
Lloyd, Jon C. (Editorial Technician)	Publications Editor	Publications
Summerville, Tyrone (Office Assistant II -Typing)	Business Clerk	Headquarters Support
Morgan, Ronald L. (Graphic Artist)	Graphic Artist	Publications
Rhodes, Beverly M. (Management Services Tech.)	Business Services Technician	Headquarters Support

HEADQUARTERS OFFICE (Continued)
1416 9th Street, Room 1341
Sacramento 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Silva, Yolanda (Management Services Tech.)	Personnel/Training Coordinator	Headquarters Support
Strand, Rudolph G. (Supervising Geologist)	Special Program Officer	Administration
Streitz, Robert (Senior Geologist)	Publications Officer	Administration, Publications
Taylor, Gary C. (Associate Geologist)	Editor, CALIFORNIA GEOLOGY MAGAZINE	Publications
Turner, Irene (Word Processing Tech.)	Word Processing Tech.	Headquarters Support
Rau, Lynette (Staff Services Analyst)	Administrative Officer	Administration
Woods, Mary C. (Associate Geologist)	Chief Editor, CALIFORNIA GEOLOGY MAGAZINE	Publications
Zeh, Cheryl (Editorial Aid)	Assistant Editor CALIFORNIA GEOLOGY MAGAZINE	Publications

BERCUT BRANCH OFFICE
610 Bercut Drive
Sacramento, CA 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Bacon, C. Forrest (Senior Geologist)	Geothermal Manager	Administration, Geothermal
Beeby, David J. (Senior Geologist)	Urban SMARA Manager	Administration, Urban SMARA
Bezore, Stephen P. (Associate Geologist)	Geologist	Geothermal
Burnett, John L. (Associate Geologist)	Geologist	Minerals
Campion, Linda (Assistant Geologist)	Geologist	Geothermal
Cole, Ken (Assoc. Engineering Geologist)	Geologist	SMARA Reclamation
Dupras, Donald (Assistant Geologist)	Geologist	Urban SMARA
Foster, Edward L. (Graphic Artist)	Graphic Artist	Publications
Higgins, Chris T. (Associate Geologist)	Geologist	Geothermal
Huckaby, Louise (Geological Drafting Tech.)	Drafting Technician	Publications
Jones, Allen Lynn (Assistant Geologist)	Geologist	Advisory Services
Kishi, Emily H. (Office Assistant II -Typing)	Geologic Aid Trainee	Geothermal
Kohler, Susan B. (Assistant Geologist)	Geologist	Urban SMARA
Leivas, Eddie (Associate Geologist)	Geologist	Geothermal
Loyd, Ralph C. (Associate Geologist)	Geologist	Minerals

BERCUT BRANCH OFFICE (Continued)
610 Bercut Drive
Sacramento, CA 95814

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Mankoski, Zoe K. (Senior Environmental Planner)	SMARA Reclamation Manager	Administration, SMARA Reclamation
Ota, Yukie (Senior Stenographer)	Secretary to Office Manager	Office Support
Rapp, John S. (Associate Geologist)	Geologist	Minerals
Riordan, Danielle P. (Office Assistant II Typing)	Office Assistant II (Typing)	Geothermal
Rubish, Frances T. (Management Services Tech.)	Drafting Trainee	Publications
Smith, R. Merl (Publications Supervisor)	Publications Supervisor	Publications
Stratton, Anna (Geological Drafting Tech.)	Drafting Technician	Publications
Tambert, Jeffrey O. (Senior Geological Draft. Tech.)	Drafting Supervisor	Publications
Van Kekerix, Lorraine (Assoc. Land/Water Use Analyst)	Reclamation Botanist	SMARA Reclamation
White, Darren (Stenographer)	Secretary	Office Support
Wilson, Mary D. (Regional Admistrative Officer)	Office Manager	Administration
Youngs, Leslie G. (Assoc. Engineering Geologist)	Geophysical Geologist	Geothermal

SACRAMENTO DISTRICT OFFICE
2815 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Alfors, John T. (Supervising Geologist)	District Geologist	Administration
Bennett, John H. (Associate Geophysicist)	Geophysicist	Geophysical Investigations
Blodgett, Juanita G. (Office Assistant II -Typing)	District Clerk	District Support
Boylan, Richard T. (Assistant Geologist)	Geologist	Geothermal
Bryant, William A. (Associate Geologist)	Geologist	Alquist-Priolo Fault Evaluation
Burgess, Mary L. (Office Technician -Typing)	Information Clerk	District Support
Campbell, Gordon L. (Geologic Aid)	Geophysicist	Geologic Investigations
Chapman, Rodger H. (Senior Geologist, Geophyst.)	Geophysics Program Manager	Geophysical Investigations
Chase, Gordon W. (Associate Geophysicist)	Geophysicist	Geophysical Investigations
Cramer, Chris H. (Associate Seismologist)	Seismologist	Seismological Investigations
Durrwachter, Ernest C. (Geologic Aid)	Micro Telluric Program	Geologic Investigations
Gibbons, Michael (Student Assistant)	Student Assistant	Seismology
Hart, Janet (Student Assistant)	Student Assistant	Seismology
Jensen, Laurel (Student Assistant)	Student Assistant	Seismology
Lowry, Polly A. (Student Assistant)	Student Assistant	Seismology

SACRAMENTO DISTRICT OFFICE (Continued)
2815 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Martin, Roger (Senior Engineering Geologist)	Volcanologist	Administration, Seismology
McGinn, Martha (Student Assistant)	Student Assistant	Seismology
Mualchin, Lalliana (Associate Seismologist)	Seismologist	Advisory Services
Naramore, Sharon L. (Student Assistant)	Student Assistant	
Park, Sharon (Student Assistant)	Student Assistant	Seismology
Parke, David L. (Geologic Aid)	Earthquake Catalog	Seismological Investigations
Pingree, Cora (Word Processing Tech.)	Word Processing Tech.	District Support
Real, Charles R. (Associate Seismologist)	Seismologist	Seismological Investigations
Schadt, Liese (Student Assistant)	Student Assistant	Seismology
Sherburne, Roger W. (Senior Seismologist)	Seismology Program Manager	Administration, Seismological Investigations
Toppozada, Tousson R. (Senior Seismologist)	Seismologist	Seismological Investigations

SAN FRANCISCO DISTRICT OFFICE
Ferry Building, Room 1004
San Francisco, CA 94111

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Armstrong, Charles F. (Associate Geologist)	Geologist	Timber Harvest Plan
Bedrossian, Trinda B. (Senior Geologist)	Geologist	Timber Harvest Plan
Bishop, Charles C. (Senior Geologist)	Assistant District Geologist	Administration
Borchardt, Glenn A. (Associate Geochemist)	Soil Mineralogist	Advisory Services
Bortugno, Edward J. (Associate Geologist)	Geologist	Regional Mapping
Brunton, Angela (Senior Librarian)	Librarian	Publications
Davenport, Clifton (Engineering Geologist)	Geologist	CDF Mapping
Deguzman, Merlyn (Laboratory Technician)	Laboratory Technician	Chemical Laboratory
Gasner, Laura (Office Services Supv. I)	Office Services Supv.	District Support
Hart, Earl W. (Senior Geologist)	Alquist-Priolo Manager	Administration, Alquist-Priolo Fault Evaluation
Huber, Oscar L. (Associate Geologist)	Geologist	Timber Harvest Plan
Jennings, Charles W. (Senior Geologist)	Regional Mapping Manager	Administration Regional Mapping
Kelley, Frederic R. (Associate Geologist)	Geologist	Regional Mapping
Kilbourne, Richard T. (Associate Geologist)	Geologist	Advisory Services

SAN FRANCISCO DISTRICT OFFICE (Continued)
Ferry Building, Room 1004
San Francisco, CA 94111

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Learned, Eleanor M. (Curator, Mineral Museum)	Curator, Mineral Museum	Publications
Love, Andrew C. (Stock Clerk)	Stock Clerk	District Support
Majmundar, Hasmukhrai H. (Associate Geochemist)	Geochemical Laboratory Manager	Administration, Chemical Laboratory
Mata-Sol, Anabal (Student Assistant)	Student Assistant	Laboratory
Manson, Michael W. (Associate Geologist)	Geologist	Urban SMARA
Moar, Richard R. (Senior Geological Draftsman)	Drafting Supervisor	Publications
Plappert, John (Jack) (Associate Geologist	Geologist	Technical Support
Rice, Salem J. (Senior Geologist)	Geologist	Advisory Services
Saucedo, George (Assistant Geologist)	Geologist	Regional Mapping
Smith, Charles B. (Laboratory Technician)	Laboratory Technician	Chemical Investigations
Smith, Theodore C. (Associate Geologist)	Geologist	Alquist-Priolo Fault Evaluation
Stinson, Melvin C. (Senior Geologist)	Urban SMARA Manager	Administration, Urban SMARA
Taylor, Eleanor Geological Drafting Tech.)	Drafting Technician	Publications
Wagner, David L. (Associate Geologist)	Geologist	Regional Mapping
Wong, Perry (Geologic Aid)	Geologic Aid	Alquist-Priolo Fault Evaluation

LOS ANGELES DISTRICT OFFICE
107 S. Broadway
Los Angeles, CA 90012

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Anderson, Thomas P. (Senior Geologist)	Country SMARA Manager	Administration, Country SMARA
Barrows, Allan G. (Senior Geologist)	Geologist	Fault Studies
Bushnell, Marjorie M. (Associate Geologist)	Geologist	Country SMARA
Cardenas, Florencia (Office Assistant II-Bilingual)	Secretary	Cal-Mexico
Cole, Judy (Assistant Engr. Geologist)	Engineering Geologist	Seismic Studies
Devney, Virginia A. (Word Processing Tech.)	Word Processing Tech.	District Support
Fuller, David R. (Associate Geologist)	Geologist	Seismic Studies
Gray, Cliffton H., Jr. (Supervising Geologist)	District Geologist	Administration
Greenwood, Richard B. (Associate Geologist)	Geologist	Seismic Studies
Hsu, Eugene Y. (Associate Geologist)	Geologist	Geologic Hazards
Huffman, Venice (Senior Account Clerk)	Clerical Supervisor	District Support
Joseph, Stephen (Assistant Geologist)	Geologist	Technical Support
Kahle, James E. (Associate Geologist)	Geologist	Fault Studies
Kiessling, Edmund W. (Associate Geologist)	Geologist	Urban SMARA
Lindgren, Elizabeth M. (Senior Geological Draft.Tech.)	Drafting Supervisor	Publications

LOS ANGELES DISTRICT OFFICE (Continued)
107 S. Broadway
Los Angeles, CA 90012

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
NeSmith, Esther (Office Assistant II -Typing)	Typist	District Support
Saul, Richard B. (Associate Geologist)	Geologist	Geologic Hazards
Spittler, Thomas E. (Associate Geologist)	Geologist	Regional Mapping
Stickney, Dale (Geological Drafting Tech.)	Drafting Technician	Publications
Torres, Sue E. (Office Technician -Typing)	Information Clerk	Publications
Treiman, Jerome A. (Associate Geologist)	Geologist	Advisory Services
Weber, F. Harold, Jr. (Senior Geologist)	Geologist	Landslide/Slope Stability Studies

GEOLOGICAL RESEARCH DIVISION
Scripps Institute of Oceanography
La Jolla, CA 92037

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Kennedy, Michael P. (Marine Geologist)	Marine Geologist	Coastal Commission/ Oceanographical Studies

U. C. RIVERSIDE GEOLOGY DEPARTMENT
Riverside, CA 92521

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Spittler, Thomas E. (Associate Geologist)	Geologist	Regional Mapping

OFFICE OF STRONG MOTION STUDY
Strong Motion Instrumentation Program
2811 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE
DaVeiga, Vicki (Seismological Instrument Aid)	Installation Aid
Farros, Janice (Machine Operator I-Photocopy)	Photo Technician
Guyer, Albert G. (Precision Elect. Specialist)	Installation Development Specialist
Hallstrom, Claudia L. (Seismological Instrument Aid)	Installation Aid
Huston, Marvin M. (Seis. Installation Tech.III)	Lead Installation Technician
Kaliakin, Nikolai A. (Senior Structural Engineer)	Data Systems Manager
Luzier, Charles E. (Seis. Installation Tech.III)	Service Technician
Meneely, Robert J., Jr. (Seis. Installation Tech. I)	Service Technician
McJunkin, Richard D. (Associate Geologist)	Geologist
Orr, Robert (Staff Program Analyst)	Data Processing Analyst
Parton, Janice (Office Assistant II -Typing)	Photo Technician
Ragsdale, John T. (Senior Structural Engineer)	Operations Manager
Rider, Stephen (Seis. Installation Tech. I)	Installation Technician
Rasnic, John (Seis. Installation Tech.I)	Installation Technician

OFFICE OF STRONG MOTION STUDY (Continued)
Strong Motion Instrumentation Program
2811 O Street
Sacramento, CA 95816

NAME AND CLASSIFICATION	WORKING TITLE
Shakal, Anthony (Senior Seismologist)	Seismology
Syphax, Vernettia G. (Office Technician -Typing)	Secretary to Chief
Weaver, Sherrill A. Office Assistant II -Typing)	Fiscal Clerk
Williams, Wayne W. (Precision Elec. Specialist)	Lead Service Technician
Wootton, Tom M. (Senior Geologist)	Chief, OSMS/SMIP
Young, Phyllis (Office Assistant I -Gen.)	District Support

MINERALS PROGRAM
28 Civic Center Plaza, Room 642
Santa Ana, CA 92701

NAME AND CLASSIFICATION	WORKING TITLE	FUNCTIONAL ASSOCIATION
Miller, Russel V. (Associate Geologist)	Geologist	Urban SMARA
Tan, Siang S. (Associate Geologist)	Geologist	Advisory Services

STRONG MOTION INSTRUMENTATION PROGRAM
303 W. 3rd Street, Room 148
San Bernardino, CA 92401

NAME AND CLASSIFICATION	WORKING TITLE
Lagesse, Harry P. (Seis. Instrument Tech.)	Service Technician

STRONG MOTION INSTRUMENTATION PROGRAM
1264-C Mt. Mesa Road
General Delivery Mt. Mesa Branch
Lake Isabella, CA 93240

NAME AND CLASSIFICATION	WORKING TITLE
McGrady, Thomas, Jr. (Seis. Instrument Tech.)	Installation Tech.

NEW HIRES
July 1, 1980 - June 30, 1981

NAME	CLASSIFICATION
Appleby, Janet	Geologic Drafting Technician
Cole, Judy Ann	Assistant Engineering Geologist
Cole, Ken	Associate Engineering Geologist
De Guzman, Merlyn	Laboratory Technician
Devney, Virginia Ann	Office Assistant II (Typing)
Hicks, Marilyn	Office Assistant II (Typing)
Hsu, Eugene Ying Chi	Associate Geologist
Johnson, Carole	Senior Stenographer
Johnson, Marsha	Office Assistant II (Typing)
Loden, Mark	Office Assistant II (Typing)
Mumm, Henry	Senior Program Analyst
Nolasco, Michael	Geological Drafting Technician
Orr, Robert	Staff Program Analyst
Porche, Marchella	Office Assistant II (Typing)
Rasnic, John	Seismological Instrument Technician I
Rau, Lynette	Staff Services Analyst
Schulte, Judy	Office Assistant II (Typing)
Silva, Mike	Geologic Aid
Silva, Yolanda	Management Services Technician
Spittler, Thomas	Assistant Geologist
Stechney, Dale	Geologic Drafting Technician
Taylor, Eleanor	Geologic Drafting Technician
Van Kekerix, Lorraine	Associate Land and Water Use Analyst
Weaver, Sherrill Ann	Office Assistant II (Typing)
White, Darren	Stenographer, Range B
Wong, Perry	Geologic Aid
Zeh, Cheryl	Office Services Supervisor I (Typing)

SEPARATIONS
July 1, 1980 - June 30, 1981

NAME	CLASSIFICATION	SEPARATION
Anderson, Carolyn	Office Assistant II (Typing)	Transferred
Broyles, Jennifer	Office Assistant II (Typing)	Resigned
Hauge, Carl	Senior Geologist	Transferred
Hendrickson, Carol	Office Assistant II (Typing)	Transferred
Lazaro De	Office Assistant II (Typing)	Transferred
Moreno, James	Geologic Aid	Transferred
Murray, Geneiva	Office Assistant II (Typing)	Transferred
Perzinski, Diane	Office Assistant II (Typing)	Transferred
Short, Jill	Office Assistant II (Typing)	Resigned
Sprotte, Edward	Petroleum Geologist	Retired
Stephens, Diane	Management Services Technician	Resigned
Stephens, Elgar	Associate Engr. Geologist	Transferred
Thompson, Michelle	Office Assistant II (Typing)	Transferred
Turner, Margaret	Editorial Aid	Retired
Woodard, Debra	Office Services Supervisor I	Transferred
Zimmerman, Laurie	Office Assistant II (Typing)	Transferred

DECEASED

Turpen, Charles	Seismological Installation Technician III	

PROMOTIONS
July 1, 1980 - June 30, 1981

NAME	CLASSIFICATION	PROMOTION
Anderson, Mildred	Senior Stenographer	Executive Secretary I
Anderson, Thomas	Assistant Geologist	Associate Engr. Geologist
Beeby, Dave	Associate Geologist	Senior Geologist
Bortugno, Edward	Assistant Geologist	Associate Geologist
Bushnell, Marjorie	Assistant Geologist	Associate Geologist
Fuller, David	Assistant Geologist	Associate Geologist
Leivas, Eddie	Assistant Geologist	Associate Geologist
Love, Andrew	Janitor	Stock Clerk
Loyd, Ralph	Assistant Geologist	Associate Geologist
Mankoski, Zoe	Staff Services Manager I	Sr. Environmental Planner
McJunkin, Richard	Assistant Geologist	Associate Geologist
Meneely, Robert, Jr.	Seismological Instrument Aid	Seism. Instrument Tech. I
Spittler, Thomas	Assistant Geologist	Associate Geologist
Syphax, Vernettia	Office Assistant II	Office Technician
Treiman, Jerome	Assistant Geologist	Associate Geologist
Youngs, Leslie	Assistant Geologist	Associate Engr. Geologist

NEW HIRES

July 1, 1981 - June 30, 1982

NAME	CLASSIFICATION
Campion, Linda	Assistant Geologist
Cardenas, Florencia	Office Assistant II Bilingual
Davenport, Clifton	Engineering Geologist
Dupras, Donald	Assistant Geologist
Espinoza, Melissa	Stenographer
Gasner, Laura	Office Services Supervisor I
Hart, Janet	Student Assistant
Jensen, Laurel	Student Assistant
Joseph, Stephen	Assistant Geologist
Mata-Sol, Anibal	Student Assistant
Mc Ginn, Martha	Student Assistant
Park, Sharon	Student Assistant
Pingree, Cora	Word Processing Technician
Plappert, John (Jack)	Associate Geologist
Rider, Stephen	Seismological Instrument Tech
Schulte, Judy	Office Assistant II
Shakal, Anthony	Senior Seismologist
Stratton, Anna	Geological Drafting Tech
Summerville, Tyrone	Office Assistant II
Syphax, Vernettia	Office Technician
Turner, Irene	Word Processing Technician
Williams, Janet	Stenographer

SEPARATIONS

July 1, 1981 - June 30, 1982

NAME	CLASSIFICATION	SEPARATION
Brannon, Thomas	Student Assistant	Resigned
Burton, William	Student Assistant	Resigned
Chin, Linda	Student Assistant	Resigned
Dichy, Charlotte	Office Technician	Resigned
Hicks, Marilyn	Office Assistant II	Resigned
Lemley, Ken	Student Assistant	Resigned
Loden, Mark	Office Assistant II	Transferred
Long, Rebecca	Office Assistant II	Resigned
Masen, Thomas	Student Assistant	Resigned
Munoz, Nellie	Office Assistant II-Bilingual	Resigned
Nolan, Martin	Assistant Transportation Engr	Transferred
Nolasco, Michael	Geological Drafting Technician	Transferred
Oman, Martha	Student Assistant	Resigned
Porche, Marchella	Office Assistant II	Resigned
Protasov, Victor	Geologic Drafting Technicial	Transferred
Schulte, Judy	Office Assistant II	Resigned
Williams, Janet	Stenographer	Resigned
Wills, Christopher	Student Assistant	Resigned

PROMOTIONS

July 1, 1981 - June 30, 1982

NAME	CLASSIFICATION	PROMOTION
Barrows, Al	Associate Geologist	Senior Geologist
Bedrossian, Trinda	Associate Geologist	Senior Geologist
Bezore, Stephen	Assistant Geologist	Associate Geologist
Boylan, Richard	Geological Drafting Tech	Assistant Geologist
Bryant, William	Assistant Geologist	Associate Geologist
Devney, Virginia (Ann)	Office Assistant II	Word Processing Tech
Farros, Jan	Office Assistant II	Machine Operator I
Greenwood, Richard	Assistant Geologist	Associate Geologist
Higgins, Chris	Assistant Geologist	Associate Geologist
Manson, Michael	Assistant Geologist	Associate Geologist
Stenson, Mel	Associate Geologist	Senior Geologist
Williams, Wayne	Seismolog. Instru. Tech III	Precision Elect. Specialist
Zeh, Cheryl	Office Services Tech. III	Editorial Aid

IIIa. Budget Summary, 1980-81

Expenditures by Program Component

Geologic Hazards and Mineral Resources Conservation Program

	Personnel Years	Dollars	Personnel Years	Dollars
Land Use Geology and Seismology Element			77	3,662,000
Basic Investigations Component	15	713,000		
Hazards Reduction Component	62	2,949,000		
Mineral Resources Conservation Element			27.9	1,269,000
Deposit Inventory Component	16.2	770,000		
Land Classification Component	9.5	449,000		
Mined Land Reclamation Component	1.2	50,000		
Geologic Information and Publication Element			19.5	1,072,000
Information Component	8.6	409,000		
Publications Component	10.9	663,000		
Administration Element			34.7	1,310,000
TOTAL EXPENDITURES			124.4	7,313,000

Source of Funds

General Fund	4,388,000
Surface Mining and Reclamation Account, General Fund	499,000
Strong-Motion Instrumentation Program Fund	1,349,000
Energy and Resources Fund	113,000
State Highway Account, State Transportation Fund	11,000
California Water Fund	11,000
Federal Trust Fund	405,000
Reimbursements	537,000
TOTAL	7,313,000

IIIb. Budget Summary, 1981-82

Expenditures by Program Component

Geologic Hazards and Mineral Resources Conservation Program

	Personnel Years	Dollars	Personnel Years	Dollars
Land Use Geology and Seismology Element			90.3	4,063,000
Basic Investigations Component	19.7	914,000		
Hazards Reduction Component	70.6	3,149,000		
Mineral Resources Conservation Element			35.8	1,742,000
Deposit Inventory Component	12.8	591,000		
Land Classification Component	17.5	895,000		
Mined Land Reclamation Component	5.5	256,000		
Geologic Information and Publication Element			23.3	1,108,000
Information Component	9.6	391,000		
Publications Component	13.7	717,000		
Administration Element			31	1,457,000
TOTAL EXPENDITURES			149.4	8,370,000

Source of Funds

General Fund	4,156,000
Surface Mining and Reclamation Account, General Fund	1,151,000
Strong-Motion Instrumentation Program Fund	1,539,000
Energy and Resources Fund	324,000
State Highway Account, State Transportation Fund	11,000
California Water Fund	11,000
Federal Trust Fund	485,000
Reimbursements	693,000
TOTAL	8,370,000

IV. Statutory Authority for the Division

The Division of Mines and Geology operates under the authority provided in the State Public Resources Code, significant parts of which are summarized as follows:

Division 1. Administration

Chapter 2. Department of Conservation

Article 1. Organization and general powers

Section 601. Established the Department of Conservation in the Resources Agency and identified the role of the Director.

Section 607. The work of the Department is divided into three divisions, known as the Division of Mines and Geology, Division of Oil and Gas, and the Division of Resource Conservation.

Article 3. State Mining and Geology Board

Sections 660 -676 Establishes the Board and its responsibilities.

Section 677. The Board shall nominate and the Director shall appoint the State Geologist. Describes the qualifications of the State Geologist.

Section 678. Provides the authority of the State Geologist.

Division 2. Geology, Mines, and Mining

Chapter 2. The Division of Mines and Geology (Sections 2201-2209 inclusive)

Section 2201. State Geologist shall employ geologists and qualified specialists to do Division's work.

Section 2203. State Geologist shall submit an annual report, including review of measures taken to counter geologic hazards, and review of economic utilization and conservation of State's mineral resources and problems related thereto, pursuant to the State Mining and Minerals Policy (Section 2650).

Section 2204. State Geologist may receive and manage gifts on behalf of State.

Section 2205. State Geologist may: Study mineral resources, mineral industries, and geology of the state; Collect mineral statistics; Collect geological and mineralogical specimens and models to constitute Division's exhibits; Provide technical library to be Division's library; Maintain, in effect, a bureau of information on the State's mineral industries; Conduct studies of geologic hazards in urban area, including activities under cooperative agreements; Maintain a laboratory to perform physical and chemical tests and analyses; Issue reports and maps on the geology of the State and the statistics and technology of the State's mineral industries; Conduct investigations in mining and metallurgy, including use of scrap mineral products, and in land-use practices applicable to mineral resources conservation; Conduct investigations in reclamation and utilization of mining waste products and reclamation of mined lands.

Section 2207. Mineral producers shall forward to the State Geologist, upon his request, annual mineral production figures. Such reports shall be confidential. State Geologist shall compile and publish statistical bulletins to show totals of minerals produced, annually.

Section 2207.1 Manufacturers or processors may, upon request, report to the State Geologist data on consumption or utilization of mineral materials. Such reports shall be confidential.

Section 2209. State Geologist may fix prices upon and dispose to the public all publications of the Division.

Chapter 7.5 Special Studies Zones
(Sections 2621 - 2630 inclusive)

Section 2622. State Geologist shall delineate Special Studies Zones to encompass potantially and recently active faults under the Alquist-Priolo Special Studies Act. He shall continually review new geologic and seismic data and revise or issue new special studies zones when warranted by new information.

Chapter 7.6. State Mining and Minerals Policy

Section 2650. Establishes the State Mining and Minerals Policy and requires the State Geologist to carry out such policy. He may include in his annual report to the Director (Section 2203) recommendations for items of legislations necessary to implement such policy.

Chapter 8. Strong Motion Instrumentation Program (Sections 2700 - 2709 inclusive)
Establishes the strong-motion instrumentation program and describes the role of the Division of Mines and Geology in its implementation.

Chapter 9. Surface Mining and Reclamation Act of 1975 (Sections 2710 - 2793 inclusive)

Establishes the Surface Mining and Reclamation Act of 1976 to regulate surface mining operations. Identifies the role of the State Geologist and the Mining and Geology Board. Requires the Board to adopt State policy for the reclamation of mined lands. Requires the State Geologist to classify lands as to their mineral potential.

V. State Mining and Geology Board

The State Mining and Geology Board is a nine-member board. Each member is appointed by the Governor to serve a four-year term. The Governor designates the chairman, who shall hold such office at the Governor's pleasure. The vice-chairman is elected annually.

The Board's responsibilities, as stated in Sections 672-677 of the Public Resources Code, are as follows:

> "The Board shall represent the state's interest in the development, utilization, and conservation of the mineral resources of the state and the reclamation of mined lands, as provided by law, and federal matters pertaining to mining, and shall determine, establish, and maintain an adequate surface mining and reclamation policy. The Board shall also represent the state's interest in the development of geological information necessary to the understanding and utilization of the state's terrain, and information pertaining to earthquake and other geologic hazards. General policies for the Division shall be determined by the Board.
>
> "The Board shall also serve as a policy and appeals board for the purposes of the Alquist-Priolo Special Studies Zones Act (Chapter 7.5, Division 2, Public Resources Code).
>
> "On or before December 31 of each year, the Board shall submit to the Governor and the Legislature recommendations regarding needed research projects relating to the state's terrain, mineral resources, mining, the reclamation of mined lands, and earthquakes and other geologic hazards.
>
> "The Board may provide for a statewide program of research regarding the technical phases of reclaiming mined lands which may be delegated to it by law and may accept funds from the United States or from any person to aid in carrying out the provisions of this section. The Board may conduct such a program independently or by contract or in cooperation with any person, public or private organization, federal agency, or state agency, including any political subdivision of the state.
>
> "The Board shall provide for a public information program on matters involving the state's terrain, mineral resources,56ining, the reclamation of mined lands, and earthquakes and other geologic hazards.
>
> "In accordance with the State Civil Service Act, the Board shall nominate, and the director shall appoint, . . . the State Geologist . . ."

The State Mines and Geology Board's Annual Report to the Governor and the Legislature is printed separately by the Board.

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